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to my wonderful family

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1. Gianfagna, Laura, and Emi Ferra. "*International frameworks and initiatives for business conduct in fragile and conflict states" The role of Institutions and culture for fragile firms in Bosnia-Herzegovina"*. Maastricht School of Management, Working Paper No. 2014/36. 2014.

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Presentations

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3. E. Ferra (with Laura Gianfagna) 4th Annual Research Conference on "Global Business, Emerging Markets and Human Rights: Old Concerns or Fresh Hopes? International frameworks and initiatives for business conduct in fragile and conflict states" in Maastricht at Maastricht School of Management, Holland, September 5th 2014.

Abstract

Whether interested or not, economy has always influenced everybody's life and daily choices. Our way of living and our important life decisions, for most of us, are framed not only by each own preference, but also and foremost by economic laws and budget constraints. Therefore, starting from real life, my interest for empirical economics has grown in different and complementary topics, ranging from consumer choices and asymmetric information in a developed world to analyzing developing countries and international trade in terms of value chains. My aim is that of connecting economic theories with empirical evidences. In fact, chapter two is a direct connection between people's health attitude and principal-agent theory which analysis follows a recent experiment that I realized in the USA. My goal is also that of showing the economic mechanism in both developed and developing countries therefore chapter three is placed in Pakistan and analyses parental level of education on female student religiosity. As a conclusion, the last chapter interests a deep economic analysis of international trade among different countries and cultures, where developed and developing countries collaborate along the value chain by taking advantage from each other in order to be able to follow the path of a common development process.

Chapter 1

Introduction

This thesis is a result of my curiosity on economic topics and interconnection between economic theory and actual data. I focused on empirical economics ranging from asymmetric information to international trade and developing world.

The second chapter comes from an idea that I had watching a documentary about sugar consumption in the developed world. It immediately attract my attention to the point of engaging myself in a deeper research at 360 degrees. In fact, I spent months in reading not only economic articles but also medical and clinical ones. At the end of the personal documentation, I decided to put into effect my knowledge by launching a randomized survey experiment in the USA[1] through Amazon Mechanical Turk. The link between economic theory of the principal agent model can be more visual by translating it into a current consumer behavior.

My interest in economic behavior through survey data is presented in the third chapter as well. Differently from the previous analysis, this time the framework is a developing country, Pakistan, and the data studied come from a survey done in 2011 about similarities and differences of level of religiosity among two groups of female girls: madrasas and college

[1] The experiment was supported by personal funding.

students. This work is a result of a co-authored work with professor Masooda Bano during my visiting period abroad at Oxford University, England.

After analyzing two different countries with diverse cultures and contrasting economic development, I focus on a deeper study of a group of countries trading among each other along the value chain and exploiting comparative advantages. This is a joint work with the associate professor Armando Rungi and PhD Candidate Davide Donofrio. This cooperation was born because of common and complementary interests. In fact, I was more attracted by the developing world while Davide Donofrio in international trade. Professor Rungi was our supervisor for this paper and contributed for the initial idea by merging our own interests. He guided us to create a complete framework from both economic theory and empirical analysis. I focused, primarily, on empirical application and econometric analysis with Stata while Davide concentrated on the literature, dataset analysis and Stata codes for the empirical application for the system of simultaneous equations.

The three chapters following the introduction are a presentation of the three papers, which content is shown in more details in the next paragraph.

Chapter 2

There is a large literature dedicated to principal-agent theory and asymmetric information and their relevance in our daily environment. In particular, there is large evidence about the contradiction between the free and easy access to information and bad health habits regarding eating behaviour, in specific, an extremely high consumption in added sugar in daily food and

drink products. In this study, I show the existence of a principal-agent problem, as described by Ross model, between US taxpayers and US government. To fulfil this goal, I designed and experiment and launched a randomized online survey in the USA through Amazon Mechanical Turk and Limesurvey to create the survey and collect data. I, then, analyze the effect given by free and clear information to the treated group.

The results show significant treatment effects which support the existence of principal-agent problem on topic such as added sugar, food products and perceived healthy food thanks to the added information for the treated group. Treatment effect appears again in the case of actual personal effort from respondents. This result shows how information can drive not only a slight change in people's thoughts but also in people's behavior. Finally, no treatment effects is shown when the respondents of both groups, treated and control, have to judge possible governmental actions. These kind of results seem to suggest that people have a stronger responsibility and awareness of power given by their own actions, instead of leaving it completely to a third party such as the government in this case.

Chapter 3

This study presents an empirical analysis of the impact of school type on students' levels of religiosity. Our work is related to that part of literature focused on the analyses of education and level of religiosity as well as parental influence on their offspring. We use a new dataset on female students of registered madrasas (Islamic schools) and secular schools from urban parts of Pakistan. On most counts of religious behaviour, the students from the two groups record broadly similar results. However,

our probit analysis shows that when we control for students' socio-economic profile and attitudes, on few counts of religiosity madrasa effect does emerge but it disappears as soon as we control for parental level of education. Our findings support the hypothesis that parental education, especially mother's education, is key to modernising religious and cultural norms in conservative societies.

Chapter 4

Over the last decades global trade has benefited from the increasing cross-country production sharing. Firms are engaged in transactions across national borders and the phenomenon has involved both manufacturing and services industries. Although it is recognized that traditional trade statistics need to be revised in order to take account of value-added, there is still little assessment of this phenomenon on a global scale and the question of how production choices interact with value-added specialization path have been relatively neglected.

In this contribution, we provide some empirical evidence of the impact of economic and financial institutions as sources of comparative advantage, along with the traditional Heckscher-Ohlin relative factor endowment determinants. We do this by estimating a global production function with a novel panel dataset at country-sector-level, WIOD, over a time span of 15 years.

We suggest that there the level of international sourcing of intermediate inputs as well as educational attainments of labor force are key determinants of performance and should be key factors to consider for policy implications. Moreover, our results point out that, consistently with previous literature, institutional

quality does have a positive effect on the value-added based specialization pattern of a country-sector.[2]

[2] Acknowledgements: This contribution is funded by Crisis Lab. Project. We thank Zhi Wang and Shangjin Wei, Bastiaan Quast, Stefan Sperlich, Marcelo Olarreaga, and Frédéric Robert-Nicoud. We thank also participants at mini-conference organized by the Academy of International Business at Bocconi University of Milan for helpful discussion and comments on preliminary draft. Data and stata codes are available on demand.

Chapter 2

Does information affect consumer's choice? Evidence from a randomized online experiment in the USA

2.1 Introduction

Internet made very easy the access to any kind of information (including wrong or misleading information), mostly at no cost and in real time; however, the lack of information and/or the misinformation about very important topics for our daily life are wide-spread. A real-life example concerns people's health: our sugar consumption habits.

High sugar consumption induces some severe diseases associated with metabolic syndrome such as: hypertension, high triglycerides and insulin resistance through synthesis of fat in the liver, diabetes, ageing process (Johson et al., 2009). Over the

past 50 years, sugar consumption has tripled worldwide[3] and only 20% of items in a regular supermarket do not contain sugar.

In particular, most of nutritionists and medical doctors point out the very significant negative effects of eating too much added sugars on people's health.

In short, added sugars are sugars and syrups added to the food during its preparation or processing, or added at the table. The American Heart Association (AHA) recommends no more than 9 teaspoons (tsp) of added sugar a day for men (38 grams) and 6 tsp for women (25 grams). The average US consumer eats approximately 19.5 tsp (or 82 grams) of added sugar a day, more than twice the recommended maximum amount.

A striking discovery is the level of misinformation on the quantity of added sugar incorporated in food and drinks often perceived by consumers as healthy. A recent empirical evidence about the level of misinformation on this topic is provided by a survey conducted in October 2016 by Healthline, a recognized health information website, in the US[4]. The results show that the majority of the respondents (62%) is aware of the health's consequences of their sugar consumption habits and they declare they do feel concerned about it. However, 70% of the

[3] Global consumption of sugar increased an average of 1.93% over the past decade, likely due to increasing income, population growth and shifts of dietary patterns. The top ten largest consumers are: India, EU-28, China, Brazil, US, Indonesia, Russian Federation, Pakistan, Mexico, Egypt. Interestingly, US produces around 7.70 mln tonn of sugar but, on the other side, they consume 10.83 mln tonn, therefore they are in deficit and in need of importing sugar from abroad.

[4] For further information on Healthline you can check directly their website on the following link:
http://www.healthline.com/health/about-us?ref=footer

respondents believe that what they perceive as healthy food contains a lower quantity of added sugar than it actually contains. Similar results are reached in a different survey conducted in the UK at the University of Glasgow which confirms that people use to heavily underestimate the content of added sugar in their food[5].

The complete discordance between US consumers' choices in terms of food and drinks habits and the suggested sugar intake from the AHA, were the starting point for the process of better understanding the interaction between consumers, the sugar market and other key players like FDA[6] (Food and Drug Administration).

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[5] This misunderstanding can also be related to the confusion given by the food labelling. In fact, the term sugar is used for table sugar or sucrose and not for sweeteners, even though these are actually forms of added sugar. Therefore, food makers can easily use sweeteners and declare that in their products there is no added sugar. Besides, in the market, there are lots of products that naturally contain sugar while other products have sugar in the form of added sweeteners. Unfortunately, food labelling laws do not currently require companies to differentiate natural sugar from the added sugar.

[6] FDA is the acronym for Food and Drug Administration, an agency within the U.S. Department of Health and Human Services. It consists of the Office of the Commissioner and four directorates overseeing the core functions of the agency: Medical Products and Tobacco, Foods and Veterinary Medicine, Global Regulatory Operations and Policy, and Operations. FDA is responsible for protecting the public health by ensuring the safety, efficacy, and security of human and veterinary drugs, biological products, and medical devices; and by ensuring the safety of our nation's food supply, cosmetics, and products that emit radiation. FDA also has responsibility for regulating the manufacturing, marketing, and distribution of tobacco products to protect the public health and to reduce tobacco use by minors. In general FDA regulates the following products (this is not an exhaustive list): food, drugs, biologics, medical devices, electronic products that give off radiation, cosmetics, veterinary products,

There are evidences, as explained in the related literature, showing the conflicts of interest between the taxpayers and the FDA because of the permission, since 1992, of collecting private industry funds in order to faster the research for the introduction of new drugs, for example. Added to that, many researchers working in the FDA receive different kind of benefits from private industries and corruption is not only a rumour inside the US agency.

The questions are: does information matters in terms of affecting consumers' choice? Is the government giving proper information to the US citizens, or people are aware and simply want to adopt wrong eating habits? What explains this level of misinformation on such a relevant topic, despite the presence of US agencies such as the FDA in charge of broadcasting information? The main question is: Is there any principal-agent problem between US taxpayers and the FDA?

In order to answer to those questions, I was interested in studying people's behaviour in front of additional information. There are parties with more complete information and others, the consumers, with a lack of information and who mostly rely on firms and advertisement rather than FDA or other governmental health agencies.

The lack of information can cause perverse behaviours, as shown by the recent enforcement of the policy concerning banning advertisement for junk food, in particular for potato chips (see Dubois, Griffith and O'Connell, 2016). In this case, the

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tobacco products, advertising, alcohol, consumer products, drugs of abuse, meat and poultry, pesticides, vaccines for animal diseases, water. For further information see:
https://www.fda.gov/AboutFDA/Transparency/Basics/ucm192695.htm

policy's result was not what policy makers were hoping, i.e. increased health for the citizens, rather than banning simply caused a lower sale price of potato chips from the producers' side and a switch to other junk food from the consumers' side.

In my experiment, I provide medical and technical information to US consumers and monitor how they react to them. Most of the information that I provide is the same offered by the FDA. The main problem that arises between the FDA and the consumers is the agency problem such as, for example, the relationship between the employer and the employee, the lawyer and the client or the buyer and the supplier. There are evidence indicating a potential conflict of interests between the FDA and consumers and those facts are not as evident as the food labeling marketing done by the FDA. Starting from 1992, the FDA obtained the authorization of the Congress, through the creation of the Prescription Drug User Fee Act (PDUFA), to collect funds from companies producing certain human drug and biological products. One of the main requirement contemplated in the act is that these funds has to be invested by the FDA in hiring more reviewers to assess application so that the drug approval process can expedite[7]. Up to 1992, taxpayers were the one and the only responsible for the FDA's New Drug Approvals Division's budget but after the creation of the PDUFA, therefore after the funds collected by brandname pharmaceutical industries, more than 50% of the budget is covered by private industries ($170 million in 2002 against $162 million). The table below shows how

[7] For further details see also the following link: https://www.fda.gov/forindustry/userfees/prescriptiondruguserfee/default.htm Starting from 1992, the PDUFA has to be reauthorized every five years therefore it was renewed in 1997, 2002, 2007, 2012 and, lately, in August 2017.

much the distance between the users fee and the taxpayers has diverged:

Table 1.a Generic Drug Program Obligations by Source, Amount and Percentage of Total Funding, Fiscal Years (FY) 2013 through 2016

	2013	%	2014	%	2015	%	2016	%
Taxpayers	$146	55	$161	42	$121	27	$121	24
User Fees	$121	45	$226	**58**	$332	**73**	$373	**76**
Total	$267		$387		$453		$494	

Source: GAO[8] analysis of Food and Drug Administration data. See document GAO-17-452[9].

The direct consequence of such an increase in the amount of funds thanks to the brandname pharmaceutical industries has correspond to a significal increase in the number of drugs approved. In fact, the loss of a manufacturer can reach the average amount of over US $1 million for each day's delay in terms of obtaining the marketing approval from the FDA. Private manufacturers can support researchers in economic terms or by giving them some other types of benefits (see Abraham John 2002).

[8] GAO is the acronym for Government Accountability Office; it is an independent, non partisan agency that works for Congress. It investigates how the federal government spends taxpayers dollars. For more information see the following link:
http://www.gao.gov/about/index.html

[9] https://www.gao.gov/assets/690/684950.pdf

For all the above reasons, the risk of a conflict of interests between the need of being protected of the citizens and the needs of the private manufacturers may exists because by economically supporting FDA they can obtain the approval of some new drugs and therefore the failure of the public policy (Lawson, 2005). In support of this suspection, there is also a letter published in the *Wall Street Journal* written by a group of scientists working at the FDA who request to the US president to restructure the agency because of the presence of corruption and distortion in the scientific review process for medical devices (Mundy and Favole, 2009)[10]. The existence of a corrupted environment inside the FDA, therefore of a conflict between the principal and agent's goals, cause, indirectly, also difficulties in terms of controlling the agent's activities. Both problems concerning the principal-agent theory emerge in this framework.

I decide, therefore, to run a randomized online experiment, by adopting a linear probability model with ethnicity fixed effects, and offer two set of robustness checks for the findings. I implemented my survey in the US on the 1st of February and I managed to collect all the data in less than three days. The survey is structured as follows: first of all, it has socioeconomic questions such as demographic ones, political leaning as well as health questions; secondly, the omnibus survey has a treated and a control section, given to different randomized people, where the treated, apart from the questions, has additional health information and economic implications while the control has only the questions; finally, to conclude the experiment, there are

[10] See the full article in the following link:
https://www.wsj.com/articles/SB123142562104564381

questions concerning recommended policies, personal efforts and trust in governmental actions.

The first set of results on healthy products and multinational food companies shows the presence of treatment effect with a high level of significance and a very important magnitude ranging from 40 to 12-percentage-point. This is a strong sign that free information does matter on shaping people's thoughts once it is shown and understood by the people. Even though, this information was supposed to be already spread around the country, it seems no to be broadcast efficiently and the presence of principal-agent problem is likely to exist between the US taxpayers and US government. In fact, there is a high level of significance of the coefficient that represents the treatment effect and the difference between the control and treated group. The second set of results, related to questions on recommended policies to be adopted by the government does not show any level of significance, therefore there is no treatment effect. Both groups, control and treated, seem to have same ideas about the government and a very low trust on it. Though, on the other side, there is a treatment effect when I ask people to sign the petition and the treated group responded positively in doing this effort by spending their time and putting their names. Finally, I observe that information does matter and it does affect people's behaviour to some extent, at least for topic concerning people's health and their daily choices on food and drink products.

2.2 Related Literature

Information easily influences the decision-making processes faced by different subjects such as individuals, private

companies and governments. It can be public, therefore free of any costs, or private, if only some individuals can use the information. The coexistence of public and private information brings the attention to the phenomenon recognized as asymmetric information. Stiglitz (2000) recognizes two types of information, information about quality and information about intent, in which cases asymmetry is particularly important. The former one happens when one individual does not possess full information as far as the characteristics of the other individual is concerned. The latter, instead, occurs when one individual is concerned about the behaviour of another individual (Elitzur and Gavious, 2003).

The importance of this topic has been largely studied in the field of economics and one particular theory dealing with this problem is the theory of principal agency. A large number of articles have been written on the theory starting from the 1970s. Initially the problem was framed around the insurance environment but soon, it was clear that the topic of information asymmetries and principal agency is particularly interesting also for other settings such as accounting, finance, marketing, political science, organizational behaviour, sociology and many more. In specific, agency theory studies the agency relationship between the principal and the agent. The former delegates work to another entity called agent that can be a person, an organization, a business activity, in charge of performing the work. The problems that arise are twofold: the agency problem when the goals of the principal and the agent conflict and the difficulty that the principal has to face in order to control what the agent is actually doing. Some examples of principal agent relationships are employer-employee, lawyer-client, buyer-

supplier. The same kind of relationship exists between the FDA and the US consumers. In fact, in this case, the FDA, an agency within the U.S. Department of Health and Human Services, is in charge of protecting the public health by ensuring the safety, efficacy and security of human and veterinary drugs, biological products and medical devices. Apart from those duties, FDA is also responsible of ensuring the safety of the U.S.' food supply, cosmetics and product that emit radiation, of regulating the tobacco market from the manufacture to the production process and the alcohol market. There are evidence indicating a potential conflict of interests between the FDA and consumers due to the fact that the FDA, in 1992, obtained the authorization of the Congress to collect funds from companies producing certain human drug and biological products in order to expedite the drug approval process. Up to 1992, taxpayers were the one and the only responsible for the FDA's New Drug Approvals Division's budget but after the funds collected by brandname pharmaceutical industries, more than 50% of the budget is covered by private industries ($170 million in 2002 against $162 million). As a consequence, the number of drugs approved has increased significantly. The existence of a corrupted environment inside the FDA, therefore of a conflict between the principal and agent's goals, cause, indirectly, also difficulties in terms of controlling the agent's activities. Both problems concerning the principal-agent theory emerge in this framework.

The principal agent theory has been studied for more than fourty years. Researchers are trying to have a better understanding about it and a significant amount of papers have been published so far and with different traits. What makes the principal-agent model so interesting, is the fact that it can be

applied in a significantly different framework. For example, principal-agent model has been of interests also for political scientists regarding the role of information, asymmetry and incentives. In fact, they have tried to explore this theory in a more applicable way for political institutions (seeGary Miller, 2005). Other authors, instead, study the principal-agent model under the framework of institutional bodies. Kassim and Menon (2003) see a promising understanding of the European institutions work through the principal-agent model. In fact, they offer a critical analysis of how the principal-agent model has been positioned by different theoretical prospective.

Generally, principals hire agents as a delegator for efficiency reason. In fact, the agent should possess special capabilities or have a lower opportunity cost in terms of time or effort. A paper, written by Hamman, Loewenstein and Weber (2010), pose the question whether the principal-agent relationship might be of interest without considering the efficiency motivation. In this case, the principal might hire an agent for other reasons such as self-interested or immoral actions. In fact, both the principal and the agent would feel less responsible for the action taken because the principal is not taking it directly while the agent is merely fulfilling a job contract. Some examples related to this case could be all the companies accused of outsourcing production to outside firms which are known to have lower ethical norms such as less rights for the workers. Another example is also given by increasing existence of a new figure in a company often called the "firing consultants" whose contribution to the company is mainly that of firing employees. In this paper, through different experiments, the authors confirm the fact that hiring an agent makes the principal feel less responsible. The principal-agent

model has been adopted also to explain how stock options and bonuses are used in executive compensation (see MacDonald and Leslie, 2001).

My study follows the evidence of a significant contrast between people's attitude towards food especially the ones perceived as healthy and actual nutritionists' judgements about those foods. Many food items and drinks are shown in the advertisement as healthy but they are not recognized as such by specialized people such as doctors or nutritionists. There is a significant misunderstanding and confusion and the fact that economic profits play a key role can partially explain the inconsistent situation. There are, therefore, parties with more complete information and others, the consumers, with a lack of them, relying in firms and advertisement. The intuition is that there is a principal-agent problem in this framework. In fact, the US citizens are paying taxes which partially are addressed to sustain one of the most important agency within the US Department of Health and Human Services: the Food and Drug Administration (FDA). Still, there are empirical evidences showing a lack in the capability of spreading important health notion about nutrition among US citizens which have one of the worst diet among the developed countries. My randomized online experiment checks whether there exist a principal-agent problem where the principal is the tax-payer, therefore the US citizens, while the agent is the FDA. I adopt the principal-agent model offered by Ross in 1973.

This work also relates to another strand of the economic literature which attempts at identifying and assessing the impact of advertising on demand and consumer choices. Bagwell (2007)

and Lewis and Rao (2015) provide comprehensive surveys and discuss this literature.

A number of papers find evidence of spillovers from advertising in the markets for alcohol and tobacco and other regulated goods. Rojas and Peterson (2008) find that advertising increases aggregate demand for beer. Eckard (1991) shows that regulating or banning advertising on cigarettes has led to more concentration in the relevant industry. Ching and Ishihara (2012) model advertising spillovers in the pharmaceutical market.

More specifically, Dubois, Griffith and O'Connell (2017) analyse a specific case in which there is a policy suggesting the restriction of junk food advertisement in order to fight the epidemic obesity. Their analysis follows the recommendations of the medical literature calling for restrictions on advertising of junk food, citing as an example Gortmaker *et al*. (2011) where they state that "marketing of food and beverages is associated with increasing obesity rates" and they study the impact of banning advertising in the U.K. market for potato chips—a typical junk food market and an important source of junk food calories. They simulate the impact of an advertising ban on market equilibrium, and they find that banning advertising, holding prices fixed, lowers potato chip demand, as well as total purchases of potato chip calories, saturated fat and salt. However, these health gains are partially offset for two reasons. First, some firms respond to the ban by lowering prices, which leads to an offsetting increase in potato chip demand. Secondly, some consumers switching out of the market choose to substitute to other less healthy junk foods.

2.3 Misinformation about Food Industry and Empirical Evidence

Among many others, two interesting characteristics are easily observable in our modern society. The first one is the fact that people living in the developed countries have an extremely easy and fast access to information foremost thanks to the easy availability of being connected to Internet while the second one is the impression that people are significantly misinformed about topics that are relevant for their health, which is also supposed to be one of the most precious thing for all of us. In particular, I was impressed by the damage that can be easily caused by the consumption of sugar, in specific, added sugar. Added sugars are sugars and syrups put in foods during preparation or processing, or added at the table. The topic is even more alarming when there is evidence of a strong divergence between the maximum amount of added sugar that we are supposed to eat, as suggested by the American Heart Association (AHA), and the amount that people used to eat in the developed countries. In fact, the American Heart Association recommends no more than 9 teaspoons (tsp) of added sugar a day for men (38 grams) and 6 for women (25 grams). For children, of course, the suggested amount is lower and it ranges between 3-6 teaspoons (12-25 grams) per day. Since my research is focused in the USA, all the data and general information about population behaviour is referring to it. The complete discordance between Americans' consumer choice and the suggested sugar intake from the AHA, was a good starting point to go further with this study in order to understand better all the relationships from the consumer to

the sugar market and other key players like FDA (or Food and Drug Administration).

Over the past 50 years, sugar consumption has tripled worldwide. The average American consumes approximately 19.5 teaspoons (or 82 grams) of added sugar daily (see Bethene and Ogden, 2013). This amount is approximately two to three times more than what is suggested by the AHA. Sugar consumption is an important topic because of its connection with health. In fact, some of the diseases induced by sugar consumption are associated with metabolic syndrome such as: hypertension, high triglycerides and insulin resistance through synthesis of fat in the liver, diabetes, ageing process (Johson et al., 2009).

In our society, intended as the one of the developed countries[11], it is quite easy to eat product with added sugar. In fact, only 20% of items in a regular supermarket does not contain sugar[12]. Besides, our ability to sustain a high sugar diet is a very new concept in terms of evolutionary times. Only during the last decades or at most last century we have the possibility to buy sugary products with a very cheap price and in big quantities. In fact, sugar has always been very hard to find and mostly it used to come from fruits and milk. Sugar it is known to give a boost in energy and contains lots of calories therefore people has always had a high crave for sugar. This ancient feeling is still in our system and this partially explain our continuous need to sugar but in evolutionary terms, our body system is not ready to manage this sudden abundance of highly refined sugar.

[11] This actually holds also for some developing countries such as Mexico where the consumption of added sugar is very high.

[12] From the movie: That sugar film.

The high desire of sugar that people can easily have, it is due to many reasons, apart from the ancient feeling of calories just mentioned before. Another reason comes from the fact that when we eat sugar, there is a very fast increase in the level of glycaemia, followed by a big drop. After assuming sugar, out body release insulin which is a hormone that drives the sugar inside the cells in order to be used for energy. Insulin gives a feeling of happiness and once the sugar is finished, suddenly we lose that feeling as well and here comes the need of such a wellbeing and that's how we can be persuaded by our own body to assume other amount of sugar. Another aspect of sugar is its effect on the brain. Sucrose, commonly known as table sugar, is composed by glucose and fructose. Fructose exerts toxic effects on the liver which are akin to those of alcohol; in fact, alcohol comes from the fermentation of sugar. The effect of sugar on the brain is that of encouraging subsequent intake because it does not suppress the feeling of being hungry (Lustig et al., 2012).

For all the above reasons, some doctors claim that added sweeteners have a clear potential for abuse therefore they should be controlled, like FDA does with alcohol, because the way sugar is eaten today make it toxic and it should be regulated. According to FDA, fructose is in the list of Generally Regarded as Safe (GRAS), which means that food manufacturers can add unlimited amounts of it to any food. It can be argued that also iron and vitamins A and D are in the GRAS list can be toxic if over-consumed but, unlike sugar, they have no abuse potential.
Another issue concerns the way the amount of added sugar is legally shown in the labelling of food and drinks products. Products that are labelled as sugar free can still contain artificial sweeteners. Moreover, since food manufacturers are not

required to notify you on the front of the package when a product contains an artificial sweetener, consumers may need to check the ingredient list carefully[13].

According to FDA, a food can be labelled with the term "sugar free" or "no sugar" if the food contains less than 0.5 g of sugars per labelled serving. Moreover, they still can contain sugar alcohols, one type of reduced-calorie sweetener. The term "lightly sweetened" is not defined by FDA, it is freely used by food industries, each applying their own definition. It is good to keep in mind that the problem is not one serving but the amount of total serving eaten per day.

The existence of a misinformation regarding the amount of added sugar in food and drink products is clearer when it comes to analysing the real amount of added sugar contained in what is perceived as healthy food or drink. In fact, what is perceived as healthy or presented as healthy through specific wording (such as sugar free, lightly sweetened) does not mean that it actually is; it can be but only if taken in a very small amount. Some examples are the following: one bar of Nutri Grain apple cinnamon cereal contains 3 tsp of sugar (both naturally and added sugars); in one small glass (240 ml) of Tropicana 100% pure orange juice there are slightly more than 5 tsp of sugar; one small container (170g or 6oz) of Dannon plain no-fat yogurt has 3 tsp of sugar. Again, another example can be one small glass of Jamba juice strawberry smoothie (real whole fruit and 100% juice) which contains 17 tsp of sugar. A medium one has 23.5 tsp of sugar while a large glass has 31 tsp. If 31 tsp of sugar were taken from the original fruit instead of drinking them, then you

[13] Information found in "The Sugar Association".

would have to eat approximately: 4 peaches, 9 limes, 30 lemons and 30 strawberries. What makes things even more complicated is the fact that by law, the gram of sugar contained in each product must be list in accordance with The Nutrition Facts Label. In the market, there are lots of products that naturally contain sugar while other products have sugar in the form of added sweeteners. Unfortunately, food labelling laws do not ask to companies to differentiate natural sugar from the added one.

Apart from labelling issues, there are also some others related to definitions. In fact, the term sugar is used for table sugar or sucrose and not for sweeteners, even though these last ones are actually forms of added sugar. Therefore, food makers can easily use sweeteners and claim that in their product there is no added sugar. Still they have to be mentioned in the label and here are some names for sugar that can be find in food labelling: agave nectar, brown sugar, cane crystal, cane sugar, corn sweetener, corn syrup, crystalline fructose, dextrose, fruit juice concentrates, glucose, high-fructose corn syrup, honey, invert sugar, maltose, malt syrup, maple syrup, molasses, raw sugar, sucrose, syrup.

There is also an empirical evidence conducted by Healthline about the misinformation of Americans regarding the level of added sugar present in food, in particular in perceived healthy food. Healthline is the fastest growing health information site and its goal is that of giving the more accurate information as possible on health, medication, suggestions for a healthier lifestyle through a comprehensive and informative content[14].

[14] For further information on Healthline you can check directly their website on the following link:
http://www.healthline.com/health/about-us?ref=footer

Healthline conducted a survey from 22nd of September to 5th of October 2016 to 3223 Americans from across the US. The survey was composed by questions in order to understand their sugar consumption habits, their knowledge about added sugar that can be find in food and drinks. Findings are statistically significant at a 95 percent confidence level and the margin of error is around +/- 5 percent. The results show that majority of the respondents, around 62%, is aware about the impact of sugar and they do feel concerned about it and about its effects on their waistline. Besides they feel also guiltier about eating more sugar than carbohydrates (22%) or fat (18%). They also show interest in taking real action with the intent to decrease their sugar intake and 10% of them have even cut off sugar from their daily diet. Even though, they also display a lack of information when it comes to the amount of added sugar present in some of the most common products in US (see table 1):

Table 1. Empirical Evidence on people's understanding of perceived healthy food in terms of added sugar content

	A vs *B*		*C* vs *D*		*E* vs *F*		*G* vs *H*	
Product comparison	A. Starbucks Chocolate Croissant	B. Dannon Strawberry Yogurt	C. Dunkin' Donuts jelly Donut	D. PowerBar Performance Energy Bar, Citrus Burst	E. Ben&Jerry's Chocolate Chip Cookie Dough Ice Cream	F. Snapple Lemon Ice Tea	G. Kellogg's Frosted Flakes Cereal	H. Haagen Dazs Vanilla Frozen Yogurt
Respondents' answers in %	67	33	74.2	25.8	73.8	26.2	63.4	36.6
Actual grams of sugar in each product	10g	24g	15g	29g	25g	36g	10g	21g

Note: this table shows how respondents have answered to the question: "Which food contains more sugar between the two products shown?". It means that respondents have to choose between product A versus B, then C vs D and so on. Respondent's answer represents the percentage of surveyed people that choose that specific product as the one that contains more sugar while the last row list the actual grams of sugar contained in one serving of the products mentioned.
Source: Healthline Survey Data

In this table, there are shown four different questions and the respondents have to answer which, between two products, contains more added sugar. One of the product is generally perceived as healthy therefore they tend to guess that this product has less quantity of added sugar. Most of the time it is wrong and this is proven by the fact that 70% or people gave a wrong answer. These results highlight the misinformation about food ingredients and added sugar.

Similar results, are given in another survey conducted in UK at the University of Glasgow[15]. Again, they interviewed around 2005 people and asked them to estimate the number of teaspoons of sugar present in some of the most popular products in the UK, in particular those perceived as healthy. This study, as the one conducted in the US, confirm the fact that people used to underestimate the level of added sugar, as well as the Americans.

As I mentioned before, sugar has two properties: one is that it does not fully supress the feeling of being hungry, and secondly, it can create a sort of addiction due to the good feeling given by the insulin that is released in our body after assuming it. These two characteristics can create a significant place for

[15] The details of the results can be seen in the university of Glasgow website: http://www.gla.ac.uk/news/archiveofnews/2012/april/headline_230642_en.html

profits if added sugar is present in daily food products. In fact, the bliss point is a good example. In the field of food products, the bliss point is the amount of an ingredient contained in a food or drink, such as salt, sugar or fat which is able to maximize the pleasure of eating that specific food. When a company gets the bliss point right, then the product typically takes off. For example, the bliss point for Mountain Dew[16] seems to be approximately 37 tsp of sugar (without considering the amount of other sweeteners such as high fructose corn syrup) in a bottle of 1.25 litres.

In terms of international market trade, sugar present significant volumes. Sugar is a commodity and, in many countries, it is included in the list of essential commodities. Mostly sugar is derived from sugarcane and sugar beet and it is produced by more than 130 countries around the world. Though, sugarcane represents 80% of global sugar production. From 1980 to 2014 there is an evident concentration of sugar production market. In fact, 37 years ago the top ten countries producing sugar accounted for 56% of the global production while now, in 2014, they account for 75%. According to the data offered by ISO (International Sugar Organization[17]), the top ten sugar producers in 2015 are the following: Brazil, India, EU-28, Thailand, China, USA, Pakistan, Mexico, Russian Federation, Australia. On the other side, global consumption increases on an average of 1.93% over the past decade and the main reasons of this raise are increasing income, population growth and shifts of dietary patterns. The top ten largest consumers are: India, EU-28, China,

[16] Mountain Dew is a typical soft drink in the USA.

[17] For further details see their website in the following link: http://isosugar.org/sugarsector/sugar

Brazil, USA, Indonesia, Russian Federation, Pakistan, Mexico, Egypt.

In particular, the US produce around 7.70 mln t of sugar but consume 10.83 mln t of sugar, which means that there is a deficit and a need of importing sugar from abroad. In fact, the US is the third largest net importers, after China and Indonesia, in mln metric tonnes, tel quell, of sugar.

The combination of all these data from different fields such as medical aspects of the effect of sugar, international trade of sugar and misinformation of perceived healthy food, pushed me to deepen my research for a better understanding of sugar as a whole.

2.4 The Experiment

2.4.1 The Randomized Survey Experiment

I implemented the experiment during three week days, specifically on the first, second and third of February 2017. I refer to this randomized survey experiment as the "omnibus" surveys. It is structured in the following way: first of all, it has socioeconomic questions such as demographic ones, political leaning as well as health questions; secondly, the omnibus survey has a treated and a control section, given to different randomized people, where the treated, apart from the questions, has additional health information and economic implications while the control has only the questions; finally, to conclude the experiment, there are questions on views of eventual policies, personal efforts and trust in governmental actions.

My research is focused on the USA for different reasons. It is easier to obtain any kind of information regarding the health and the food consumption of the population and it is easier also to collect more reliable answers from the online survey. In fact, the majority of the people using Amazon Mechanical Turk is from the USA, where this service was born18.

2.4.2 Data Collection

The omnibus survey was openly posted on Amazon Mechanical Turk for three days, specifically from the first to the third of February. On Mturk I had to write a brief description of the survey and each respondent was payed $0.70 for 5 minutes survey in case she\he was assigned to the control group or $1.25 for 10 minutes survey if assigned to treated group; this means that they were payed approximately from $7.5 up to $8.4 hourly wage (cf. the US federal minimum hourly wage is $7.2519). Other characteristics of the survey are the possibility of taking up to one hour to answer all questions so that respondents did not feel pressured and in order to avoid mistakes mostly given by time constraint. As a comparison, the median hourly wage on

[18] Amazon is also trying to put this service in other countries but it takes time due to the different taxation present in each country and the difficulty of finding an agreement.

[19] See the website of United States Department of Labor: https://www.dol.gov/whd/regs/compliance/posters/flsa.htm

MTurk in September 2015 was calculated to be around $5.5420 (cf. the US federal minimum of $7.25).

In order to ensure the validity of the results, I opted for some specific characteristics regarding the way the survey was supposed to be launched by MTurk. Firs of all, in order to avoid foreign respondents, I asked Amazon to show the survey only to those who had US address. Second, I launched the survey during East Coast daylight hours on workdays so that I could both limit the participation of foreign respondents and decrease heterogeneity. Third, to exclude robots, I applied two rules: (i) I allowed to take the survey only to respondents with a completion rate equal and higher of 95% (ii) before starting the survey, we set a CAPTCHA21 for survey access. Forth, I wanted to avoid respondents who has a little of experience and are serious when it comes to completing a task therefore I allowed only respondents who has already completed 50 or 100 tasks. Fifth, in order to avoid the same respondent to fill the survey of both groups, treated and control, I first launched the treated survey, then I blocked the respondents that completed it and afterwards, I launched the survey related to the control group. Sixth, respondents were told that at the end of the survey there is

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[20] As a reference see: Stewart, Neil, et al. "The average laboratory samples a population of 7,300 Amazon Mechanical Turk workers." *Judgment and Decision Making* 10.5 (2015): 479.

[21] The term CAPTCHA stands for Completely Automated Public Turing Test To Tell Computers and Humans Apart. In other words, a CAPTCHA is a program which aim is that of protecting websites against bots. This is possible the program can generate and grade tests which are possible for humans but not for current computer program. A simple example is given by the well-known distorted text which can be easily read by humans but not by current computer programs, at least not yet.

a password that they have to put in amazon in order to be paid by 24 hours. Seventh, thought Limesurvey, I could obtain the IP address of each respondents as a further check. Finally, to discourage respondents from skipping some questions, I set a compulsory mode for each of them so that the survey can be fully completed.

2.4.3 The Omnibus Information Treatment

The treatment group is characterized by additional information in comparison to the control one because my aim is that of creating a "shock" to the respondents' knowledge about health in reference to food industry, FDA and governmental policies. The information is obviously simplified due to time and budget constraint and respondents' concentration constraint. My aim is that of testing the existence of a treatment able to move any peoples' opinion and effective action.

The treatment is composed by three main parts. The first part is composed by a set of questions regarding personal characteristics such as socioeconomic and demographic questions relative to income, family composition, age, ethnicity, level of education, employment status etc. Other questions refer to health condition and personal attitude towards food industry. The second part is composed by a set of information to acknowledge people about daily issues regarding food offered by the big food industries in terms of sugar content and relative health problems. More specifically, I give information regarding the amount of hidden added sugar in common food, especially on those perceived as healthy by most of the people. I inform about some techniques adopted by most of the big firms and

brand of the food industry who treat sugar as a profitable good and this mentality can easily lead to doubts regarding the relative healthiness of such consumption. Since this is a health issue then some information is given regarding to the role of FDA (Food and Drug Administration) about labelling procedure and governmental role. Finally, the third part of the questions refer to eventual change in daily consumption behaviour of respondents after acknowledging the information just mentioned above. Though, the main focus is analysing and measuring respondents' answers regarding eventual governmental policies and their own efforts in case of willingness to change the current situation.

The randomized survey experiment is fully reported in the appendix A.3 of this paper. The italic sentences are the additional information valid only for the treatment group. The questions are the same for both groups.

2.5 Data and Summary Statistics

Through Amazon Mechanical Turk service for recruiting respondents and Limesurvey software for the creation of the survey and data collection, I could launch my randomized online survey experiment, or omnibus experiment. Table 1 shows all the characteristics of all the respondents that fully completed the online survey sample (N=409). To get a deeper understanding of the data I decided to compare them to two different nationally representative sample of US adults. One of them is a survey launched by Columbia Broadcasting Company (CBS) poll in 2011. As a second comparison, I choose a more representative

survey, the American Life Panel (ALP)[22], gathered by RAND. Those two surveys were chosen for different reasons: easy access to their data and similar questions to our online survey.

To be able to match our MTurk sample with the other two surveys, CBS and ALP, I created some weights (see Kuziemko et al., 2015) with respect to 16 cells. Those cells are based on some of the main characteristics of the samples: gender (2) x age brackets (2) x white versus non-white (2) x college degree holder versus non-holder (2). The results are shown in the table below:

Table 2. Summary Statistics and Comparison to other polling and online data

	mTurk sample (1)	CBS election poll (2)	American Life Panel (3)
Male	0.592	0.476	0.417
Age	35.956	48.99	48.940
White	0.802	0.739	0.676
Black	0.083	0.116	0.109
Hispanic	0.051	0.098	0.180
Other racial/ethnic group	0.064	0.021	0.041
Employed (full or part)	0.682	0.587	0.557
Unemployed	0.046	0.104	0.103
Married	0.333	0.594	0.608
Has college degree	0.443	0.318	0.309
Political views, conservative (1) to liberals (3)	2.259	1.586	
Observations	409	808	1002

[22] The American Life Panel is significantly more expensive compared to MTurk; in fact, in 2011 the cost was around 3$ per subject per minute and even though it is more representative, it still conserves some limitations in terms of sample size.

Notes: This table shows all the summary statistics of the main variables of the MTurk randomized online survey (see column 1). Instead, in column 2 and 3 there are the weighted averages of respectively CBS election poll and American Life Panel, the two surveys used as a comparison[23].

Table 2 shows the main characteristics of the MTurk sample: as expected, respondents are younger and there are more males. Besides there are slightly more white and less black or Hispanic, they are more educated and seems to be more liberal.

In the next table, instead, there are listed all the main personal characteristics of the two groups. In order to check for randomness, I calculated the p-values of the two-sample proportion test. The results are shown in table 3.

[23] The dataof the CBS election poll and American Life Panel are online and are taken from the personal website of any author of the paper Kuziemko et al. 2015.

Table 3. Summary statistics of the treated and control group in terms of covariates

	Treated	Control	Difference (p-values)
	(1)	(2)	(3)
Male	0.563	0.622	0.222
Age	35.966	35.945	0.985
White	0.774	0.831	0.150
Black	0.096	0.070	0.332
Hispanic	0.067	0.035	0.137
Asian	0.058	0.045	0.554
Married	0.322	0.343	0.650
Has a college degree	0.442	0.443	0.992
Number of Children	0.740	0.756	0.712
Weigh (in lbs)	177.101	174.856	0.599
Disease or allergy	0.216	0.214	0.953
Unemployed	0.058	0.035	0.272
Not in labour force	0.077	0.055	0.366
Voted for Republican in 2016	0.011	0.837	0.044
N	208	201	409

Notes: This table shows all the summary statistics of the main characteristics of the MTurk respondents divided into treated and control group (see column 1 and 2). Instead, in column 3, there are the p-values of the two-sample proportion test and only in two cases there are the p-values of the two tailed t-test statistic for age and weight since these two variables are considered continues while all the rest are binary variables.

The third column resumes the results of the two-sample proportion test and the respective p-values. The null-hypothesis

is that between the two proportions, in this case the two groups represented by the control and the treated, have no difference. The p-values confirm this result almost in any characteristics of the interviewed with the exception of the last variables about voting for Republican if I consider an alpha equal to 5%. In sum, I can assume that the way people answered was surely random.

2.5.1 Survey Attrition

Another important characteristic of the omnibus survey experiment is the analyses of the attrition rate. As I already mentioned in the section dedicated to MTurk and Limesurvey, I built the survey and the relative questions by setting a compulsory mode for each of them, in order to avoid distraction and the risk that respondents could randomly skip questions without noticing. This means that to obtain the code for the payment you are supposed to fill all the questions. Besides, I allowed only respondents with a completion rate of equal and above 95% on the past tasks which itself makes a significant selection concerning the reliability of the respondents when it comes to filling the survey. As a consequence, the rate of attrition is extremely low, approximately 1.7% for the whole sample, therefore just 7 people did not complete the online randomized survey. More precisely, the control group presents an attrition rate of around 2.9% and the treated group of just 0.48%[24]. Four respondents dropped the omnibus survey at the very first page

[24] In the case of the control group, just 6 respondents out of 207 did not fill the survey while only 1 respondent over 209 did not execute the survey for the treated group.

of the CAPTCHA code, the rest dropped either at the first two questions or at the middle of the survey. Since the overall attrition rate is extremely small, I am not going to make further analyses.

Another question arise regarding completed surveys: what is the ability of covariates to predict treatment status? Table 3 displays the results of 13 separate regressions of the following form:

$$Treatment_i = \beta Covariate_i + \varepsilon_i,$$

where "i" identifies the individuals (the respondents) and the dependent variable identifies whether a respondent was assigned to treatment or not. For each regression, there is one covariate and most of them are already listed in table 2.

Table 4. Do covariates predict treatment status for finished online surveys?

	Coefficient	*P*-value
Male	-0.061	0.223
Age	0.000	0.985
Black	0.087	0.327
Hispanic	0.167	0.117
Asian	0.066	0.552
Other ethnicities	-0.312	0.085
Married	-0.024	0.651
Has a college degree	-0.000	0.992
Number of children	-0.002	0.9
Unemployed	0.129	0.258
Not in labour force	0.089	0.36
Voted for Obama in 2012	0.081	0.17
Voted for Hilary in 2016	0.009	0.842

Note: The coefficients are the results of 13 regressions coming from the following form: Assigned to treatment$_i$ = βCovariate$_i$ + ε_i, where all the covariates are listed in the left, the coefficient in the second column and the p-values in the last column.

As shown in Table 4, there is only one covariate with a low significance level: other ethnicities. Even though, the number of other ethnicities is very low, just 5 respondents, and four of them happened to be in the control group. Because of this reason, we do not consider it as a systematic attrition from the sample.

In general, it does not seem to exist a specific pattern or category of people assigned to the treatment group. I am quite lucky in this regard because one might have expected that

conservatives or healthier people would have been not very satisfied with the additional information and easily create and attrition to the online survey.

2.6 Results from the Randomized Online Survey

In this section, I present three sets of results. The first one relates to questions on health food product, food industries and responsibilities of the FDA (or Food and Drug Administration). The second set of questions analyse eventual policies such as the application of a tax on profits of multinational food industries producing food with a high content of hidden sugar and respondents' trust in government. Last, I investigate respondents' political engagement and their personal efforts.

2.6.1 Views on Health, Food Industries and their Products and FDA

Table 4 displays the effect of the randomized online survey on questions related to perceived healthy food, food industries and their profits and products, food labelling and FDA. For each question, there are two columns: the first one shows the results without including the covariates while the second column of each question includes standard controls (which, in general, correspond to those listed in table 3). For both cases, I include racial/ethnic fixed effect. The equation of the linear probability model that gives the results for table 5 and 6 valid only for even column is the following:

$$\text{Dependent variable}_{ie} = \beta_1 \text{Treated}_{ie} + \beta_2 X_{ie} + \delta_e + \varepsilon_{ie} \quad (1)$$

Where "i" indexes the individuals, "e" the racial/ethnicity, δ_e are the racial/ethnicity fixed effects. The dependent variable is always a binary one therefore I am dealing with a linear probability model. "X" represents the set of covariates which coincide with the one listed in table 4. For the odd-column, instead, the formulation is the same, with the only exception that the covariates are not included[25].

As you can see from table 5, including or excluding covariates, does not actually make a significant change in the results, confirming the results of table 4 where it was assumed that, conditional on finishing the online survey, it exists a very low correlation between treatment status and standard covariates.

[25] The equation, therefore, will be as follows: $\text{Dependent variable}_{ie} = \beta_1 \text{Treated}_{ie} + \delta_e + \varepsilon_{ie}$.

Table 5. Main results of the effect of the randomized online survey on opinions about perceived healthy product, food industry, food label and FDA

	drinking perceived healthy product		treat sugar as alcohol		misleading food label		food industry and its profits	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treated	**0.431*** **	**0.421*** **	**0.126** **	**0.116** **	**0.168*** **	**0.154*** **	0.039	0.034
	(0.045)	(0.045)	(0.049)	(0.048)	(0.039)	(0.039)	(0.024)	(0.024)
Constant	0.285***	0.22	0.376***	-0.043	0.721***	0.469***	0.914***	0.768***
	(0.032)	(0.137)	(0.034)	(0.147)	(0.032)	(0.114)	(0.02)	(0.081)
Covariates	No	Yes	No	Yes	No	Yes	No	Yes
N	409	409	409	409	409	409	409	409

Note: The four dependent variables are binary indicator. They are coded as 1 if the respondent answers that "drinking one large glass of a perceived healthy food is unhealthy or very unhealthy", agree or strongly agree that "the government should intervene and behave towards sugar as strict as with the alcohol", agree or strongly agree in the statement that "food labels are misleading without the need of breaking the rules settled by the FDA" and agree or strongly agree in the statement that "multinational food industries put profits ahead of people's health" respectively. To see the exact wording and additional information given to the treatment group, check in the appendix A.3 from question 19 to question 22. All regressions have racial/ethnic fixed effect, even those labelled as "no" covariates. The independent variables are the same as the one listed in table 3 and two more variables are added: weight and a dummy variable assuming the value 1 in case the respondent has a disease and/or allergy.
Standard errors in parentheses.
The level of significance is the following:
****Significant at the 1 percent level;*
***Significant at the 5 percent level;*
**Significant at the 10 percent level.*

As you can see from table 5, the results of the first two columns are both highly significant and shows that the treatment is associated with a 43-percentage point, in the case of no covariates, and 42-percentage-point in the case where dependent variables are included. These results refer to the question whether it is unhealthy to drink a large glass of a product such as a smoothie made with real whole fruit, which is easily perceived as healthy. The magnitude of the results that reflect the difference between the control and the treatment group is quite robust and large.

The third and fourth columns show the effects on respondents' opinion of whether they agree or not in the claim that government should treat sugar as strict as with the alcohol. Both of them are statistically significant but with a smaller magnitude comparing to the other claims. It presents a 13-

percentage-poin for the no covariate case and approximately 12-percentage-point for the case with inclusion of other controls.

The third question relates to the claim that "food labels are misleading because they try to attract potential consumers and hide unhealthy ingredients without breaking the rules settled by the FDA". In this case, the treatment is associated with approximately a 17-percentage-point, in the case of no controls, and 15-percentage-point in the case of inclusion of the covariates. In both cases, there is a high level of significance.

Finally, column 7 and 8 are not significant therefore it seems that there is no difference in the answer between the control and treated group, partially explained also by a very high level of the constant, almost close to 1. The respondents were asked to answer whether they agree or not to the claim that multinational food industries put profits ahead of people's health. Such a result was actually expected and both groups, by just looking at the statistics, seem to agree to such a claim in almost the same percentage[26].

In general, I can claim that the omnibus treatment presents very strong results in terms of food consumption. It seems that people are quite elastic in changing their views about sensitive topic such as health and food products which play a central role in our daily life and are able to shape our behaviour. By offering to people simple and quite exhaustive information, they seem

[26] The two groups have almost the same number of respondents each: 201 respondents in the control group and 208 in the treated one. The percentage of people agreeing with the claim on multinational food industry are 95.19% in the case of the treated group (corresponding to 198 respondents) and 91.54% in the case of the control group (corresponding to 184 respondents). This might explain part of the reason why the control "treated" does not show any level of significance.

willing to adjust their preferences, or at least, their ideas. This is the first evidence of a principal-agent problem between the US taxpayers and the US government, in particular FDA in charge of spreading health knowledge and protecting consumers.

2.6.2 View on Public Policy and Trust in the Government

As I already mentioned, I wanted to analyze also people's opinion in term of eventual policies that can be applied to try to improve the actual situation. The first policy presented was that of applying a 10% tax on food industries profits if their food products were containing a significant amount of hidden added sugar[27] per serving; the second policy, instead is that of using the tax on profits just mentioned to offer to children at the elementary school free education on healthy food. Table 6 shows the results regarding respondent's policy preferences.

Table 6. Effect of the omnibus treatment on Policy Preferences

	tax on profits		use tax for free education		trust in government	
	(1)	(2)	(3)	(4)	(5)	(6)
Treated	0.066	0.052	0.036	0.027	-0.03	-0.026
	(0.048)	(0.047)	(0.043)	(0.042)	(0.039)	(0.039)
Constant	0.58***	0.205	0.74***	0.361***	0.21***	0.173
	(0.035)	(0.145)	(0.031)	(0.139)	(0.029)	(0.122)
Covariates	No	Yes	No	Yes	No	Yes
N	409	409	409	409	409	409

[27] For more information, see also the added information given to the treated group on the online survey in the appendix A.3.

Note: The three dependent variables are binary indicator. They are coded as 1 if the respondent answers that "s/he agrees in the idea of applying a 10% tax on the profits of food industries that produce food with a high level of added sugar per serving", "s/he agrees in using the money collected by the tax to sustain free education in elementary school about healthy food", "s/he trusts in government". To see the exact wording and additional information given to the treatment group, check in the appendix A.3 from question 24 to question 26. All regressions have racial/ethnic fixed effect, also those labelled as "no" covariates. The independent variables are the same as the one listed in table 3 and two more variables are added: weight and a dummy variable assuming the value 1 in case the respondent has a disease and/or allergy.
Standard errors in parentheses.
The level of significance is the following:
****Significant at the 1 percent level;*
***Significant at the 5 percent level;*
**Significant at the 10 percent level.*

According to the results, none of the two policies offered to the randomized online survey happened to report any significance level in terms of treatment. This means that both groups, treated and control seem to have the same ideas regarding policies or, differently, they do not show any significant divergence on policies. This conclusion might be supported also by the fact that they have the same trust in the government, as it is shown in column 5 and 6. In this case, added information have no effect on people's belief because, either treated or not, they do not change their original trust in government and policies views.

2.7 Political Engagement and Personal Efforts

The results of table 6 are very interesting and deserve further research because there is a common judgement in terms of tax policies regardless of the added information given to the treated group.

Table 7 displays summary statistics on demographic and policy views only for the control group, therefore there are included the respondents who did not receive the additional information. I divided them between liberals and conservatives, respectively in the first and second column while the third column includes both of them together with the moderate group.

Table 7. Summary Statistics for the control group, divided into Liberals and Conservatives

	Liberals (1)	Conservatives (2)	All (3)
Male	0.611	0.592	0.622
Age	34.295	39.735	35.945
White	0.832	0.878	0.831
Black	0.074	0.041	0.070
Hispanic	0.042	0.020	0.035
Asian	0.032	0.041	0.045
Married	0.211	0.510	0.343
Has a college degree	0.495	0.388	0.443
Number of Children	0.537	1.082	0.756
Weigh (in lbs)	172.147	178.980	174.856
Disease or allergy	0.232	0.327	0.214
Unemployed	0.042	0.020	0.035

Not in labour force	0.053	0.061	0.055
Voted for Obama in 2012	0.979	0.265	0.746
Voted for Republican in 2016	0.011	0.837	0.303
Voted for Hilary in 2016	0.884	0.102	0.567
Did not vote or voted for other parties in 2016	0.105	0.061	0.129
Trust Government	0.221	0.286	0.214
Drinking Jamba Juice (smoothie with natural fruit) is unhealthy	0.326	0.163	0.289
International food industry puts profit ahead of people's health	0.926	0.918	0.915
Food labels are misleading	0.758	0.653	0.721
Govn't should be strict on sugar as with alcohol	0.432	0.265	0.373
Tax policy on high sugar level food industries	0.705	0.367	0.577
Money from tax policy invested in free health education	0.821	0.612	0.731
Said would petition for tax on profits	0.474	0.245	0.388
Actually signed the petition	0.242	0.102	0.189
N	95	49	201

Notes: this table shows summary statistics of control group only in terms of demographic and policy views. The respondents are split into self-reported liberal versus conservative status. The question presented a five-point scale answer: very liberal (1), liberal (2), moderate (3), conservative (4), very conservative (5). Column 1 presents the results regarding liberals therefore less than 3 on scale while column 2 shows the results concerning conservatives, more than 3 on scale. Finally, column 3 displays the summary statistics for the control group therefore including liberals, conservatives and moderate (equal to 3 on the scale). The full question is reported in the Appendix A.3 and it refers to question number 11.

As expected conservatives have more children, seem to be older, slightly more white and significantly more likely to be

married. On the other side, more liberals have a college degree, they would pay more for a healthier food consumption, they are significantly more inclined in supporting a tax policy on profits of international food industry and they would agree in using the money collected to be invested in free education for children. In fact, more liberals than conservatives would sign a petition asking for a tax on profit on food industries producing unhealthy food and they did an effort for that by actually signing the online petition. Regarding the trust on government, both views, liberals and conservatives, seems to have a quite low consideration.

It seems that Americans do not distance themselves in terms of tax policies which can be seen as something far from their daily life. This is the reason why I want to analyse whether the two group are different by affecting their time and beliefs. In fact, the last set of results (table 8) analyses respondents' view about political engagement and personal efforts. For political engagement, I refer to the willingness and the consecutive actions taken to try to improve the current situation by signing a petition. I built an online petition on the website "We The People", created by the White House to give voice to people for any concern they have. Of course, the petition should reach a precise minimum number of people to be then considered by the American Government[28].

[28] In my case, I built two independent petitions with very similar text, shown in the Appendix A.3 under question 26 of the online survey, and I showed one to the treated group and the other to the control group. I could obtain all the signatures and count them. Even though I decided to show only the online website but without making it active. I made this choice because the link that "We The People" gave me was not directing immediately to the petition; the way to find it was very hard and it would take more than 15 minutes to figure

Table 8. Effect of the omnibus treatment on Personal Efforts

	Signed the petition	
	(7)	(8)
Treated	**0.112*** **	**0.116*** **
	(0.043)	(0.042)
Constant	0.192***	-0.246**
	(0.028)	(0.123)
Covariates	No	Yes
N	409	409

Note: The dependent variable is a binary indicator. It is coded as 1 if the respondent answers that "s/he signed an online petition about the first policy mentioned related to the 10% tax". To see the exact wording and additional information given to the treatment group, check in the appendix A.3 question 27/28. The regression has racial/ethnic fixed effect, also those labelled as "no" covariates. The independent variables are the same as the one listed in table 3 and two more variables are added: weight and a dummy variable assuming the value 1 in case the respondent has a disease and/or allergy.

Standard errors in parentheses.

The level of significance is the following:

****Significant at the 1 percent level;*

***Significant at the 5 percent level;*

**Significant at the 10 percent level.*

it out, therefore I just opted for the existence of the link without making it active, but people did not know about that. To be sure that people actually signed it, I asked, as a following questions, whether they actually signed or not. I think that it is quite reliable because some people initially said that they would sign the petition, then I showed them the link and afterwards I asked them whether they actually signed and those who did not, they just said it in the next question. There is little reason to not say the truth because there is no punishment. I took question 27 of the online survey in the appendix A.3 as a confirmation of that effort.

This table is the most important among all results because it shows the connection between stated behavior and actual behavior. Here the information treatment has an actual effect in real life and this fact gives significanat value to the experiment. The results are showing that the treatment group is making a bit more effort by signing the petition comparing to the control one by 11 or 12-percentage-point, respectively in the case without and with the covariates.

Finally, further improvement can be done in this study, such as increasing the number of people interviewed and check the consistency of the results if N augment. Another important step which can be used as a robustness is that of launching a follow-up survey after some time to check the consistency of people's answers and see whether the treated group of the first round still give the same answers by getting the control survey in the follow-up.

2.8 Robustness Check

For the robustness of my results I show the comparison between the benchmark results, see table 5 and 6, with the ones of the probit model. I used the linear probability model instead of probit because I am mostly looking for the average results and I am not interested in the ones in the tale. Still, by adopting LPM or probit results should be similar and they are shown below in table 9 a,b,c and d.

Table 9a. Comparison between LPM and Probit

	LPM	Probit	LPM	Probit
	Drinking perceived healthy product		International food industry puts profit ahead of people's health	
Treated	0.421***	1.18***	0.034	0.307
	(0.045)	(0.137)	(0.024)	(0.19)
Constant	0.03	-1.41***	0.74***	-0.368
	(0.15)	(0.467)	(0.102)	(0.692)
N	409	408	409	385

Note: The odd columns represents the results of the linear probability model while the even ones refers to the probit model. Both have ethnicity fixed effects. The odd columns results are the same as the one in table 5.
Standard errors in parentheses.
The level of significance is the following:
****Significant at the 1 percent level;*
***Significant at the 5 percent level;*
**Significant at the 10 percent level.*

Table 9b. Comparison between LPM and Probit

	LPM	Probit	LPM	Probit
	Food labels are misleading		Govn't should be strict on sugar as with alcohol	
Treated	0.154***	0.642***	0.116**	0.318**
	(0.039)	(0.153)	(0.048)	(0.131)
Constant	0.409***	-0.804	0.049	-1.298***
	(0.126)	(0.497)	(0.166)	(0.462)
N	409	404	409	408

Note: The odd columns represents the results of the linear probability model while the even ones refers to the probit model. Both have ethnicity fixed effects. The odd columns results are the same as the one in table 5.
Standard errors in parentheses.
The level of significance is the following:
****Significant at the 1 percent level;*
*****Significant at the 5 percent level;*
******Significant at the 10 percent level.*

Table 9c. Comparison between LPM and Probit

	LPM	Probit	LPM	Probit	LPM	Probit
	Tax policy on high sugar level food industries		Money from tax policy invested in free health education		Said would petition for tax on profits	
Treated	0.052	0.152	0.027	0.099	0.066	0.177
	(0.046)	(0.131)	(0.041)	(0.146)	(0.048)	(0.131)
Constant	0.14	-0.982**	0.422***	-0.22	0.027	-1.386***
	(0.165)	(0.458)	(0.144)	(0.524)	(0.16)	(0.453)
N	409	408	409	383	409	408

Note: The odd columns represent the results of the linear probability model while the even ones refers to the probit model. Both have ethnicity fixed effects. The odd columns results are the same as the one in table 6 and 8.
Standard errors in parentheses.
The level of significance is the following:
****Significant at the 1 percent level;*
***Significant at the 5 percent level;*
**Significant at the 10 percent level.*

Table 9d. Comparison between LPM and Probit

	LPM	Probit	LPM	Probit
	Actually signed the petition		Trust Government	
Treated	0.116***	0.405***	-0.026	-0.102
	(0.042)	(0.147)	(0.039)	(0.148)
Constant	-0.149	-2.245***	0.017	-1.984***
	(0.144)	(0.504)	(0.124)	(0.623)
N	409	404	409	404

Note: The odd columns represent the results of the linear probability model while the even ones refers to the probit model. Both have ethnicity fixed effects. The odd columns results are the same as the one in table 6 and 8.
Standard errors in parentheses.
The level of significance is the following:
****Significant at the 1 percent level;*
***Significant at the 5 percent level;*
**Significant at the 10 percent level.*

As we can see, all tables, from 9a to 9d, show similarities between the LPM model and the probit model, both include ethnicity fixed effects. In fact, the level of significance is the same while the magnitude is higher in the case of the probit model. Secondly, I want to compare the stability of the results if I add an interaction terms with the treated variable in the list of covariates. Therefore, I calculate the effects on the treated variable by adding another control variable which is an interaction term between treated and male for example. In total, I run 5 different LPM regressions with different interaction terms each. Table 10 (a,b,c and d) shows the results.

2.9 Further Analyses: Interaction Terms

Table 10a to 10d show the results after adding one interaction term in the main regression. More specifically, the first column is the benchmark or the same regression as the one presented in table 5, therefore the LPM with ethnicity fixed effect. The second column represents the same equation but this time I added an interaction term between the treated and gender which variable is called male. The title of each column explains the covariate used for the interaction with the variable treated. Therefore, the third column is the interaction with the variable about the employment status, the third with the marital status, the forth with the binary variable about having one or more children and the last one about college attendance. All these variables are binaries.

Table 10a. Comparison between the benchmark and the results of the treated with interaction terms

	Food labels are misleading					
	Benchmark	Male	Unempl.	Married	Child	College
Treated	0.154***	0.213***	0.156***	0.131***	0.102**	0.133**
	-0.04	-0.061	-0.041	-0.046	-0.044	-0.052
Male	-0.051	0.000	-0.052	-0.05	-0.058	-0.051
	(0.045)	(0.070)	(0.045)	(0.045)	(0.044)	(0.045)
Unemploy.	0.103*	0.093*	0.126	0.098*	0.089*	0.1*
	(0.053)	(0.053)	(0.128)	(0.053)	(0.052)	(0.053)
Married	-0.051	-0.055	-0.051	-0.086	-0.042	-0.049
	(0.05)	(0.05)	(0.05)	(0.072)	(0.05)	(0.049)
Child	-0.031*	-0.03	-0.031*	-0.03*	-0.071**	-0.032*
	(0.018)	(0.018)	(0.019)	(0.018)	(0.032)	(0.018)
College	-0.014	-0.016	-0.014	-0.014	-0.022	-0.038
	(0.04)	(0.04)	(0.041)	(0.04)	(0.039)	(0.065)
Inter. Term (treated*1,2, 3,4,5)		-0.099	-0.037	0.07	0.071**	0.047
		(0.079)	(0.134)	(0.087)	(0.033)	(0.079)
Constant	0.469***	0.442***	0.467***	0.473***	0.499***	0.473***
	-0.114	-0.118	-0.115	-0.115	-0.115	-0.115
Interaction term	No	Yes	Yes	Yes	Yes	Yes
N	409	409	409	409	409	409

Standard errors in parentheses.
The level of significance is the following:
****Significant at the 1 percent level;*
*****Significant at the 5 percent level; *Significant at the 10 percent level.*

Table 10b. Comparison between the benchmark and the results of the treated with interaction terms

	Tax policy on high sugar level food industries					
	Benchmark	Male	Unempl.	Married	Child	College
Treated	0.052	0.074	0.046	0.055	0.083	-0.024
	-0.047	-0.074	-0.048	-0.057	-0.053	-0.065
Male	-0.022	-0.002	-0.019	-0.022	-0.018	-0.022
	(0.052)	(0.075)	(0.053)	(0.053)	(0.052)	(0.052)
Unemploy.	-0.084	-0.087	-0.164	-0.083	-0.075	-0.091
	(0.123)	(0.124)	(0.188)	(0.123)	(0.124)	(0.125)
Married	0.029	0.027	0.029	0.034	0.024	0.037
	(0.058)	(0.058)	(0.058)	(0.081)	(0.058)	(0.058)
Child	-0.003	-0.003	-0.004	-0.003	0.021	-0.007
	(0.023)	(0.023)	(0.023)	(0.023)	(0.03)	(0.023)
College	-0.004	-0.004	-0.004	-0.004	0.001	-0.09
	(0.048)	(0.048)	(0.048)	(0.048)	(0.048)	(0.069)
Inter. Term (treated*1,2, 3,4,5)		-0.037	0.128	-0.009	-0.042	0.171*
		(0.096)	(0.249)	(0.102)	(0.037)	(0.095)
Constant	0.205	0.195	0.212	0.204	0.187	0.217
	-0.145	-0.148	-0.146	-0.145	-0.146	-0.144
Interaction term	No	Yes	Yes	Yes	Yes	Yes
N	409	409	409	409	409	409

Standard errors in parentheses.
The level of significance is the following:
****Significant at the 1 percent level;*
***Significant at the 5 percent level; *Significant at the 10 percent level.*

Table 10c. Comparison between the benchmark and the results of the treated with interaction terms

	Money from tax policy invested in free health education					
	Benchmark	Male	Unempl.	Married	Child	College
Treated	0.027	0.073	0.017	0.07	0.075	0.077
	-0.041	-0.065	-0.043	-0.049	-0.047	-0.056
Male	0.017	0.057	0.021	0.015	0.023	0.017
	(0.046)	(0.067)	(0.046)	(0.046)	(0.046)	(0.046)
Unemploy.	0.099	0.092	-0.033	0.108	0.113	0.104
	(0.082)	(0.083)	(0.195)	(0.081)	(0.082)	(0.083)
Married	-0.003	-0.007	-0.004	0.065	-0.011	-0.008
	(0.05)	(0.05)	(0.05)	(0.068)	(0.05)	(0.049)
Child	0.024	0.025	0.023	0.023	0.061***	0.027
	(0.017)	(0.017)	(0.017)	(0.016)	(0.023)	(0.017)
College	-0.022	-0.023	-0.022	-0.022	-0.014	0.035
	(0.042)	(0.042)	(0.042)	(0.042)	(0.043)	(0.062)
Inter. Term (treated*1,2, 3,4,5)		-0.077	0.211	-0.134	-0.066**	-0.113
		(0.082)	(0.202)	(0.089)	(0.03)	(0.083)
Constant	0.36***	0.339**	0.372***	0.353**	0.333**	0.352**
	-0.139	-0.14	-0.139	-0.138	-0.139	-0.139
Interaction term	No	Yes	Yes	Yes	Yes	Yes
N	409	409	409	409	409	409

Standard errors in parentheses.
The level of significance is the following:
****Significant at the 1 percent level;*
***Significant at the 5 percent level; *Significant at the 10 percent level.*

Table 10d. Comparison between the benchmark and the results of the treated with interaction terms

	Trust Government					
	Benchmark	Male	Unempl.	Married	Child	College
Treated	-0.026	0.037	-0.007	-0.028	-0.016	-0.08
	-0.039	-0.062	-0.04	-0.045	-0.043	-0.052
Male	0.042	0.096	0.033	0.042	0.043	0.041
	(0.043)	(0.061)	(0.043)	(0.043)	(0.043)	(0.043)
Unemploy.	0.047	0.036	0.305	0.046	0.049	0.041
	(0.1)	(0.099)	(0.194)	(0.1)	(0.1)	(0.101)
Married	0.091*	0.086*	0.092*	0.086	0.089*	0.096*
	(0.05)	(0.052)	(0.05)	(0.067)	(0.051)	(0.051)
Child	0.032	0.033*	0.033*	0.032	0.039	0.029
	(0.02)	(0.02)	(0.02)	(0.02)	(0.028)	(0.02)
College	-0.024	-0.025	-0.024	-0.024	-0.022	-0.086
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.058)
Inter. Term (treated*1,2, 3,4,5)		-0.105	-0.411*	0.01	-0.014	0.123
		(0.081)	(0.214)	(0.09)	(0.034)	(0.079)
Constant	0.173	0.144	0.149	0.173	0.167	0.182
	-0.122	-0.118	-0.121	-0.122	-0.122	-0.121
Interaction term	No	Yes	Yes	Yes	Yes	Yes
N	409	409	409	409	409	409

Standard errors in parentheses.
The level of significance is the following:
****Significant at the 1 percent level;*
*****Significant at the 5 percent level; *Significant at the 10 percent level.*

The results of table 10a to 10d are very interesting in understanding people's behaviour toward daily habits in food and drink consumption. In fact, when it comes to the sentence claiming that food labels are misleading, there is a treatment effect and in particular for those who have children. People who were in the treated group and have children and had the chance to understand the confusion given by the food labels through the added information, seem to be even more worried about such topic. Again the same people show more interested in offering the collected taxes from the unhealthy companies to give free teaching to pupils about health education. Instead, in the question related to apply tax policy to companies who sell product with high content of added sugar there is no treatment effect. Though, college people from both group seem to be more prone to such policy. Last, in the question related to the trust on government, there is no treatment effect but in both groups, the unemployed people seem to have even less trust than the others on the US government. Thanks to interaction terms, the results have a more define shape and meaning. I applied the interaction term to all the remaining questions but they have no significant coefficient. Those tables are listed in the appendix A.

2.10 Conclusions

The randomized online survey experiment launched through Amazon Mechanical Turk and Limesurvey in the USA, show the existence of a principal-agent problem, which reference model is the one shown by Stephen Ross in 1973, between the US taxpayers and US government in terms of health, drink and food consumption and protection. Due to a controversial environment

where information is easy to obtain and mostly free while people daily habits seem to be unhealthy about topics such as added sugar intake, healthy food and drink items, food industry, governmental policies and personal efforts. All these topics are not random but they follow a precise red line which connect all of them: added sugar content on food and drink perceived as healthy. My aim is checking the existence of any treatment effect, and therefore a principal-agent problem, by giving additional information to the treatment group with respect to the control group.

The first set of results on healthy products and multinational food industries show the presence of treatment effect with a high level of significance and a very important magnitude. In fact, the highest peak reached by the treatment effect is 40-percentage-point to 12-percentage-point. This is a strong evidence showing that principal-agent problem does exist because the US agency, FDA, in charge of sharing health knowledge to the taxpayers, seems to be weak in this goal. In fact, if you give simple and clear information to the people, they show a change in their thought and even more, they make an effort for such a change. The second set of results do not show any treatment effects. Questions are related to eventual policies that the government can apply but results do not show any level of significance. This means that the two groups have very similar ideas on that topic and, after a deepen analyses, it might be possible that this result is driven by the pre-existence of a low trust in the government from both groups.

The third set of results show again the presence of treatment effects when it comes to make some effort in term of time and personal efforts. The treated group that received the additional

information seems to be more prone to spend some time in understanding the petition and put their name for supporting it. The free information show an effect not only on people's thought but also on people's real actions. All the results are supported by a set of robustness checks by running not only a linear probability model but also a probit model. Besides, a deeper study is done by adding another covariate as interaction term with the variable "treated" and results give a clearer shape to the previous one. As a conclusion, the main results show the clear presence of a principal-agent problem in one of the most developed countries, the USA.

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Chapter 3

Family versus School Effect on Individual Religiosity: Evidence from Pakistan

3.1 Introduction

Since September 11, in international security debates madrasas (Islamic schools) have been associated with Islamic militancy. This concern has been particularly strong about madrasas in Pakistan as many Taliban leaders were schooled in madrasas on the borderland of Pakistan and Afghanistan (Rashid 2010). Consequently, many development agencies have attempted to invest in madrasa modernisation programmes[29]. Survey based studies aimed at comparing students from madrasas to those in modern schools and colleges in terms of their socio-economic background, attitudinal differences and the levels of trust they

[29] United States, for instance, provided an aid package to General Musharraf's government soon after September 11 for implementation of a madrasa reform program. Due to major distrust of the religious community on the United States as well as on General Musharraf the program failed to enlist most madrasas with the result that the program was closed in 2007.

have on their peers as well as the broader society have also grown (Mwaura et al. 2008; Asadullah et al. 2015). The starting assumption guiding such interventions, and also many existing studies, is that madrasa enrolment leads to heightened levels of religiosity. This assumption, however, is often not properly tested or is at best measured through very simplistic questions about participation in ritual practices. The results presented in this paper question such assertions.

Drawing on survey data on girls in final years of madrasa and modern colleges in urban Pakistan, we show that it is difficult to argue that levels of religiosity between the two groups are divergent. On most counts of religious behavior the students from the two groups do not show statistically significant differences. In fact, even college girls show very high levels of religiosity, which is understandable in society with high level of religious prevalence. Further, our probit analysis shows that when we control for students' socio-economic profile and attitudes, on few counts of religiosity madrasa effect does emerge but it disappears as soon as we control for parental level of education. Within the broader literature on sociology of education regarding school versus family effect in shaping individual religiosity, the findings of this study thus weigh in favour of the latter[30].

[30] Traditionally drawing on evidence from Catholic or Jewish schools in the West, academics have been keen to demonstrate the effect of religious schools on students' social attitudes including their levels of religiosity (Barrett et al. 2007; Tritter 1992). Competing evidence instead emphasizes the effect of household religiosity levels both in shaping the preference for religious schools (Cohen-Zara and Sander 2008; Sander 2005) as well as the levels of religiosity (Hill 2011). Religious beliefs are transmitted from parents to children in both direct and indirect ways (Benson et al. 1989; Bisin and Verdier 2001). Yet other

We started this study because of the dissimilarity between a general secular school and a madrasa school and this fact can support the belief of an expected difference in terms of the level of religiosity. There have been many madrasa schools in different countries and with different goals. In our study, we focus on female madrasa located in the urban area of Pakistan. More specifically, madrasa schools are Islamic schools and they exist since centuries ago. Historically, female madrasa system started operating in Pakistan only in mid to late 1970s whereas the male madrasa network has operated in South Asia since the twelfth century. Traditionally, madrasas were places for training the socio-political elites in Muslim societies covering modern as well as religious subjects (Hefner and Zaman 2007). However, under the colonial and post-colonial period and the consequent establishment of western educational institutions in Muslim countries, madrasas lost their importance and focused only on religious subjects. Today, in all Muslim countries, there are some kind of madrasa networks, either formal or informal, which goal is that of imparting specialized Islamic knowledge in parallel to the state schooling system. Starting from primary level, the bigger madrasas run all the way to providing specialized degrees in Islamic subjects, which are equivalent to a master

studies have shown even broader societal factors having an impact on one's religiosity. One of them is the nation itself (Kelley and De Graaf 1997) with its traditions and customs, which tend to remain similar over the years and therefore reinforce people's way of living and thinking. Outside the nuclear family there are many figures that can also exercise influence such as friends (see Spilka, Hood, Hunsberger and Gorsuch 2003) and classmates and teachers inside a school environment (Benson et al. 1989). Instead of finding any madrasa effect we find that mother's education has a positive effect on allowing girls to adopt more liberal religious norms.

degree in Islamic Studies from a government university[31]. However, in some countries, such as Pakistan, madrasas have attracted the international attention especially after September 11 mainly because of the expected association between madrasas and Islamic militancy. Since we are dealing only with female madrasa, the main concern is that girls might absorb more conservative Islamic norms, comparing to girls attending secular schools. This is the reason why madrasas in Pakistan are a good case to test how participation in a religious versus secular school effects an individual's level of religiosity.

Our research aims to analyse and connect two branches of the literature dealing with education and level of religiosity as well as parental influence on their children. More precisely we are interested in the religious impact of educated female student in Pakistan as well as the influence on female level of religiosity controlling for parental level of education. They key role is played by the intergenerational level of education and the subsequent effect on the level of religiosity. The initial framework is focused on the analysis of the effect on the level of religiosity based on the attendance of madrasa or secular college and after that, we introduce the concept of parental level of education. In some countries, such as Pakistan, education and level of religiosity are connected because there exist schools, called madrasa, where student have to attend subject such as literature, history, maths as well as religious classes. Our first question is: is it the level of religiosity affected by attending a

[31] The secular educational institution equivalent to female madrasas is female colleges, which offer a four-year bachelor degree program to girls of similar age. Girls come to both these institutions after completing their matric (Grade 10) in a high school thus having similar educational background.

madrasa or a secular school? And if so, does the level of parental education have any influence in that?

Only few decades ago it has been given a particular weight and importance to religiosity in terms of effect on economic development (Deneulin and Rakodi, 2011). In fact, religion has been typically not included in the list of determinants of economic growth. Differently was proved, by the use of instrumental variables by Barro and McClearly, 2003. They claim that growth depends on the degree of believing relative to belonging. Besides, economic performance increases thanks to the effect of religious beliefs on individual traits. Religion plays a key role as it is encountered into the list of determinants, either positive or negative of economic growth (see also Grier 1997; Noland 2005).

Differently from religion, education has been recognized from early stage as a significant determinant in terms of development and growth. The effect of education has been studied broadly and from different aspects. On one side, there are the micro labour studies which analyses the monetary return to schooling (Cohen and Soto, 2007) while, on the other side, there are macro studies focused on effect of education on GDP growth rate (Krueger and Lindahl, 2000). Another branch of literature, instead, has empirically shown the positive effect of growth on schooling (Bils and Klenow 2000). In our paper, we do not explain causality but we show some interesting relationship by interconnecting all this literature in our empirical study.

The structure of the paper is as follows. Section 3.2 shows the main works of the related literature; Section 3.3 presents the context of Pakistan and the core features of the madrasa and the regular schooling system. Section 3.4 outlines the survey design

and empirical evidence. Section 3.5 presents the probit model and key results while Section 3.6 shows the robustness checks. Finally, section 3.7 concludes.

3.2 Related Literature

Since the beginning of the twentieth century, it was strongly recognized the important role played by religion in terms of social change. On the other side, only lately, it has been recognized its importance as a determinant of growth. Finally, nowadays religion plays a key role not only on social activities but also personal choices which summed together can create a social movement or trend or economic growth (Guiso, Sapenza and Zingales, 2003). For instance, Barro and McClearly (2003), claim that growth depends on the degree of believing relative to belonging. Besides, economic performance increases thanks to the effect of religious beliefs on individual traits. Religion plays a key role as it is encountered into the list of determinants, either positive or negative of economic growth (see also Grier 1997; Noland 2005). Our main interest lies in the interconnection between religion and one of the most important part that can lead to an economic growth: education.

It has been proven, that it exists a positive relationship between group membership, such as a religious group worshiping a specific faith, and education (see Glaeser E. and Bruce I. Sacerdote, 2008). The public rhetoric, or secularization thesis, has often sustained the natural common sense of some "stylized facts" related to religiosity such as: i) with the improvement of science and technology, religion must inevitably

decrease; ii) the more an individual is educated and the less religious he or she becomes; iii) indoctrination leads to deviant religions[32]. Along the decades, these three claims have been proved in different ways to be false (see Stark and Bainbridge 1985, Hadden 1987, Greeley 1989). Not only religion is related to a higher level of education but there is also evidence (see Boppart et al., 2013) where the educational performance is affected by religion via home effort and education expenditure. This phenomenon happens when conservative political attitudes has a prevalence comparing to the other political views. Therefore, religious heritage is not included into the set of characteristics that do not allow economic progress. They conclude claiming that the role played by religion can be subject to changes over time along with sociocultural changes. Another evidence shown in Sacerdote and Glaeser (2001) is that religious attendance increases significantly with education across individuals. According to Lehrer (1999), there is evidence to sustain that in some cases religion is considered to be a determinant of education attainment. As it is shown, there is a strong literature who supports the positive relation between religion and education.

Another part of literature, related to our final topic, is the relationship between parents and offspring in terms of influence of the parents on education, religiosity, lifestyle of their children and so on and so forth. Becker and Tomes (1986) try to explain this relationship through models of income transmission and inequality. In this case, they consider the offspring with an initial level of endowments given by their natural parents. The Markov

[32] These three styled facts are mentioned also in the paper of Iannaccone and Finke (1996).

process is used to define the transmission of the endowment which can be subject to either an increase or an erosion. Besides, they affirm that more educated parents brings to more educated offspring. Even though, if the parents' level of education is particularly high, then their children are more likely to pursue a higher level comparing to the mean of the considered population but not comparing to their own parents. Another aspects is that parents can influence the human capital of their children and even their future earnings by spending on their skills, health and so on. The parental influence can be extended to the economic position, motivation of their children (see Haveman and Wolfe, 1995). Another study highlights the evidence of specific associations between parents and their children (see Taubman-Ben-Ari, Mikulincer and Gillath). Bisin and Verdier (2001), for instance, support the thesis that religious beliefs are transmitted from parents to children in both direct and indirect ways. In fact, their study starts with the assumption that cultural attitudes, such as preference, norms, the role of religion, the importance of education and so on, are considered to be endogenous with respect to socioeconomic system. More specifically, there are many evidences suggesting the high dependence of children's preferences on those of their parents.

Our study lies in between of the two streams of literature mentioned above. On one side, there is a branch of literature supporting the existence of a relation between schooling and religiosity while on the other side, there is evidence of interconnection between parents and their offspring in terms of religiosity, schooling, lifestyle and so on. Our goal is that of embracing both literatures therefore, we try to understand the relationship between educated and religious parents and level of

religiosity of their children, attending either a religious or a secular college.

3.3 Background: Secular Schools and Madrasas in Pakistan

Madrasas, Islamic schools, are a centuries old institution of learning in the Islamic world. Traditionally, madrasas were places for training the socio-political elites in Muslim societies covering modern as well as religious subjects (Hefner and Zaman 2007). However, with the establishment of western educational institutions in Muslim countries during the colonial period, madrasas became marginalized and came to focus purely on study of religious subjects. Having lost its socio-economic significance, madrasas in the colonial and post-colonial period failed to attract the socially and economically more affluent classes drawing more and more children from lower income groups. In all Muslim countries, today some kind of madrasa network (formal or informal) aimed at imparting specialized Islamic knowledge runs in parallel to the state schooling system. The graduates of these institutions are trained mainly to take on a position as religious teachers, mosque imams, etc. However, in some countries, such as Pakistan, madrasas have become focus of international attention since September 11 because of an alleged association between madrasas and Islamic militancy.

Such concerns mainly stems from evidence that many of the Taliban leaders had studied in madrasas in Pakistan. Actual profiles of militants in Pakistan, however, show that a very small

number actually comes from madrasas. There are also other concerns about madrasa education: focused purely on religious subjects, it is argued to breed sectarianism and intolerance and reinforce a patriarchal value system. Such concerns are also expressed about female madrasas, which unlike the male madrasas are normally not associated with militancy[33]. It is assumed that girls in madrasas absorb conservative Islamic norms, which restricts their well-being, such as allowing men to have four wives at any given time when women must secure a divorce before remarrying; women inheriting half the share of men; or need of two female witnesses against one male witness in matters of commerce. Girls in madrasas are argued to imbibe these restrictive religious norms and thereby limit their well-being.

Madrasas in Pakistan thus present a good case to test how participation in a religious versus secular school effects an individual's level of religiosity. A country of over 180 million, Pakistan shares many features common to developing countries. Despite rapid urbanization an estimated 62 percent of the population still residing in the rural areas. GDP per capita income during 2012-2013 was US$ 1,368 (Ministry of Education 2014). State has traditionally prioritized spending on building military defense over investment in human capital. Education sector has thus consistently underperformed due to lack of adequate resources as well as poor governance. While there are many private institutions of excellence from primary to tertiary level, the state education system at the primary and secondary

[33] One exception was Jamia Hafsa, a female madrasa in Islamabad that in 2007 supported an armed resistance against General Musharraf's government for the latter's unqualified support of US 'war on terror'.

level is severely underperforming. Consequently, the education landscape in Pakistan is highly mixed. The overall literacy rate is only 58 percent and an estimated 6.7 million children remain out of school (Ministry of Education 2014).

The poor education standards in state schools have in turn made many parents even from poor families to send their children to low-fee private schools (Andrabi et al. 2006a). Accordingly to UNESCO Institute for Statistics, close to 35 percent of children in Pakistan[34] are now going to private schools many of them catering to children from poor families (Andrabi et al. 2006a). Madrasas education is yet another alternative to the poor state schooling system. Starting from primary level, the bigger madrasas run all the way to providing specialized degrees in Islamic subjects, which are equivalent to a master degree in Islamic Studies from a government university. The actual number of madrasa students as share of total population is estimated to be relatively small (Andrabi et al. 2006b). However, their influence in the society through becoming religious teachers and preachers is much greater than reflected in the numbers. Female madrasas primarily offer a four-year specialized Islamic Studies program for girls in the age range of 16-20 years. The secular educational institution equivalent to female madrasas is female colleges, which offer a four-year bachelor degree program to girls of similar age. Girls come to both these institutions after completing their matric (Grade 10) in a high school thus having similar educational background.

The expansion in demand for female madrasas in recent years has been particularly strong. Female madrasa system

[34] Data available online, accessed on 11 December 2016. http://data.worldbank.org/indicator/SE.PRM.PRIV.ZS

started operating in Pakistan only in mid to late 1970s whereas the male madrasa network has operated in South Asia since the twelfth century. Yet within forty years, female madrasas have come to constitute 20 per cent of the total madrasa population in Pakistan. Given their growing numbers, it is thus important to assess concerns that madrasa education can restrict female agency by making women endorse restrictive gender norms[35]. This paper thus focuses on comparing the religiosity between students of madrasas and college girls to see if being in a madrasa indeed increases girls' religiosity and their preference for absorbing more conservative religious norms that restrict their own agency.

It is important to highlight that recently, the number of studies related to madrasas have increased considerably and mostly because, after September 11, they were constantly linked with Islamic militancy. Madrasa schools became a sort of target for the western policies aiming at a process of Islamic de-radicalization since some of the Taliban leaders located in the border between Pakistan and Afghanistan were trained in this type of schools. As explained in Bano 2015: "Reforming madrasas has been an officially recognized part of the soft side of the US 'war on terror', which has mainly relied on use of military force including drones. Madrasa reforms have mainly focused on introducing modern subjects in madrasa curriculum with the view that it will increase madrasa students' access to formal job market therefore reducing appeal for militant Islam". For this reason the religious and the secular schools are comparable in terms of subjects studied and future job aspirations but still they

[35] For a discussion on how religious or cultural norms can make women form self-confining preferences see Kabeer (1999).

are not perfectly the same. Madrasa prepares better for religious studies while college schools are more prepared for other specific subjects.

Madrasa and secular schools have the main difference based on the fact that the former includes a significant number or religious hours, differently from the latter. The reasons driving parents' (or girls') decision to enroll one of the two schools are different, as shown in some interviews to the parents (see Bano 2010). In fact, some are drivine by the job market condition, the cost of the school, the location o the personal girl aspiration. Each family has a quite high number of siblings comparing to the average in the more developed countries. It is culturally recognized as good to have at least one child attending a madrasa school. Since one the of major subject is Islamic studies, generally students prone to increase their Islamic knowledge tend to enroll or because forced by the parents. College schools are more advanced for other subjects because they dedicate more time to them and less time to religious studies. What we can assure is that the reasons of sending a child into a madrasa or into a college school are extremely different and they depend from numerous variables such as family background, economic condition, students desire. There is no specific bias in term of school preference because the reasons differ significantly and the coice of one school to another can be easily seen as random. In the next chapter, we are going to deepen our research in term of level of religiosity of female students by introducing the research design and the empirical evidences.

3.4 Research Design and Empirical Evidence

The survey was implemented in Lahore and Rawalpindi, two important cities of Punjab, the most populated and politically resourceful province in Pakistan. Lahore is the provincial capital and Rawalpindi is twin city to Pakistan's federal capital, Islamabad. A leading madrasa and a leading college were selected in both the cities. The selected institutions were from among the most prominent institutions representative of their school type in each city. Delavande and Zafar (2015) in their study of trust levels between madrasa and college students in Pakistan use very similar rationale for selecting Lahore and Rawalpindi as the field sites and for focusing on the most prominent institutions of each type to develop their student sample. Students were selected randomly from the two school types using the school register. A total of 282 girls were selected from the two colleges and 195 girls were selected from the two madrasas. In each institution, the survey was implemented by seating all the sampled girls in large hall, normally made available by the participating school. The questions were read out aloud by a research assistant and students were required to mark their response directly on the questionnaire. It took on an average an hour to complete the questionnaire. The questionnaire had six main sections: individual characteristics, family profile and socio-economic background, state of health, locus of control, levels of religiosity, and future aspirations.

Special thought was given when developing questions aimed at measuring religiosity. There is a rich literature, especially within sociology of religion, dedicated to identifying the various components of religious behavior that together arguably help

determine individual or collective levels of religiosity. McAndrew and Voas (2011) in a paper titled Measuring Religiosity Using Surveys, argue that religion being highly complex phenomenon is multidimensional in construct. Noting that there is a difference between religious affiliation (nominal association with religion by birth) and religious commitment (attitudes, behavior and values), they argue religiosity to be concerned with the latter. While it is agreed in the literature that quantification of religiosity is possible, there are no clear standards regarding which of the following aspects, preferred by different studies, should be measured: belief, practice, formal membership, informal affiliation, ritual initiation, doctrinal knowledge, moral sense, core values, or how one regards others. Consequently, studies attempting to measure the impact of school type on levels of religiosity focus on different dimensions of religiosity shaped by what to the authors of those studies is the most convincing measure of religiosity in the given context.

Studies on madrasas have normally simply focused on questions about ritual practice. The questionnaire developed for this survey instead focused on capturing three core dimensions of religiosity: ritual practice, the degree of conviction in fairness of Islamic rulings, and aspirations to be close to God. Such a three-dimensional approach was thought to provide more meaningful understanding of one's religiosity than one just focusing on levels of ritual practice. It is widely acknowledged in studies on religiosity that ritual observance is often not the most accurate measure of one's level of religious conviction (Barrett et al. 2007). Participation in ritual practices can be motived by various factors such as a desire to express conformity with expected group norms especially in contexts where lack of

observance of the rituals can lead to exclusion from the group. The need to differentiate between responses to publicly observable rituals and private religiosity has therefore been emphasized routinely in the studies attempting to measure levels of religiosity (Barrett et al. 2007).

Since madrasas in Pakistan are boarding facilities, it is difficult to treat ritual practice as the best indicator of religiosity as group effect in this case could be expected to have higher impact. Therefore, in this case, the other two dimensions of religiosity were seen to be more important: conviction in the fairness of Islamic norms, and stated aspiration to be close to God. The survey instrument thus developed explicit questions to measure these three dimensions of religiosity. Ritual practice was measured by asking respondents if they performed a specific religious ritual and if yes then how frequently. Ritual practices covered included both obligatory Islamic rituals as well as some optional ones: five compulsory prayers plus the optional tahajjud (midnight prayer); fasting in Ramadan, and levels of giving under the compulsory Islamic obligation of zakat as well as the optional forms of giving sadeeqa and kheerat.

Belief in fairness of Islamic norms was tested by narrating some of the basic Islamic rulings on gender which from a liberal perspective are seen to deny women their basic rights—such as men having the permission to have four wives, women having half the inheritance, and two witnesses required for one male witness in matters of commerce— and asking the girls, if in their view, by giving men that right, Islam gives women lower status than men.

Aspiration to be close to God was measured by asking a number of questions within the section on aspirations that could

help measure one's desire for religious piety. Key dimensions covered were: aspirations to have time, place, and freedom to pray and pray regularly; to have the time, a place, and freedom to read the Quran and to read the Quran regularly; to have the time, freedom, and the means to do Hajj; to have religious virtue in eyes of those around you; to have religious virtue in her own eyes, and to have religious virtue in the eyes of Allah.

Table 1 presents chi-square results for the two groups on selected counts of religiosity. Typically, in those cases it is used t-test difference in means. In our case, due to the fact that most of the variables are dummies, we can only test for the chi-square. The number of female students answering to each question is always different and the number of female students belonging to madrasa or college is not the same as well. The percentage of the answers are not the same therefore we want to test whether this difference is random or not. As we can see, in almost all the cases, there is not enough evidence to suggest an association between school type and selected dimensions of religiosity because all the different distributions are just random. The few exceptions, by looking at the p-values, are the first two questions relative to ritual practice. We can claim that, by doing a simple statistic analyses, there is no empirical evidence regarding the eventual difference in the level of religiosity of female madrasa student compared to college students, with only few exceptions related to the first three questions about the ritual practice.

Table 1. Levels of Relisiotisy for Madrasa and College

	Madrasa		Secular			
	Mean	**S.D.**	**Mean**	**S.D.**	**X^2**	**p-value**
a) Ritual Practice						
How many times do you pray in the day?	5.240	0.460	3.547	1.482	221.502	0.000
Do you donate Zakat?	0.500	0.501	0.694	0.461	16.6577	0.000
Do you donate Sadaqa?	0.965	0.184	0.901	0.298	7.0101	0.008
Do you donate Kheerat?	0.876	0.330	0.900	0.299	0.6564	0.418
Have you completed the Arabic recitation of the Quran (at least) one time?	0.985	0.118	0.968	0.174	1.5719	0.210
b) Convictions on Fairness						
Do you think that, by allowing men to marry four wives, Islam gives women lower status than men?	0.104	0.308	0.069	0.254	0.732	0.392
Do you think that, by giving women half the inheritance rights of men, Islam gives women lower status than men?	0.080	0.272	0.056	0.230	1.134	0.287
By giving female witnesses half the weight of male witnesses in a court of law, Islam gives women lower status then men?	0.028	0.215	0.169	0.375	16.476	0.200
c) Aspired Levels of Closeness to God						
Do you aspire to have the time, a place, and freedom to pray and to pray regularly?	0.990	0.098	0.996	0.059	0.000	0.999

Do you aspire to have the time, a place, and freedom to read the Quran and to read the Quran regularly?	0.995	0.069	0.964	0.184	0.0207	0.886
Do you aspire to have the time, freedom, and the means to do the Haaj?	1.000	0.000	0.982	0.132	2.923	0.087
Do you aspire to have religious virtue in the eyes of those around her?	0.980	0.138	0.931	0.252	0.000	0.976
Do you aspire to have religious virtue in her own eyes?	0.990	0.098	0.985	0.119	0.482	0.487
Do you aspire to have religious virtue in the eyes of Allah?	1.000	0.000	0.982	0.132	2.880	0.090

Source: Own data

Note: The answer of each question is a dummy therefore where 1 and 0 correspond respectively to the answer "yes" or "no", with the only exception concerning the first question on ritual practice. The answer of question 1 goes from 0 to 6 and each value corresponds respectively to the following response: one, two, three, four, five, five plus night prayer.

Thus, looking across the sub-variables of levels of religiosity, it is difficult to argue that madrasa education leads to significantly higher levels of religiosity. On the two most critical measures of levels of religiosity, desire for closeness to good, and conviction in fairness of Islam, the girls in colleges show equally high scores (see Bano, 2015). Besides, in her paper, Bano explains another aspects concerning the results offered by the table 1 as follows: "It is also relevant to consider that ethnographich fieldwork carried out in Pakistan shows that group-effect in madrasas rather than personal convinction in religion is most likely the main reason explaining the relatively higher number of prayers per day for madrasa girls comparing to college. In fact, in madrasas, students have to attend prayers and daily Quran

reading as part of publicly visible rituals. To measure if actually madrasa students have a significantly higher level of religiosity, there is the need of furthering the reaserch at a slightly deeper level as shown in the next chapter.".

3.5 The Model

Many studies have suggested and empirically proved the presence of parental influence, either direct or indirect, on the religiosity of their offspring (Martin, White and Perlman 2003). We show similar results in case of madrasa education and college students through a probit model, similar to one used by Asadullah and Chaudhury (2010), using level of religiosity as a dependent variable.

$$Y_i^j = CM_i\beta_1 + P_i\beta_2 + Z_i\beta_3 + v_i, \quad (1)$$

where "i" is an index identifying each student interviewed whereas "j" is an index indicating the number of the question related to the level of religiosity which corresponds to the dependent variable (j=1,2,3,4). CM is a dummy specifying whether a female student is going to a secular school or to a madrasa whereas P contains personal characteristics and attitude of female students including accommodation, level of education, health condition, number of hours spent per day watching television; Z identifies a list of household characteristics of the respondent.

There are few variables that need further explanation. Female student level of education completed is a categorical variable

which range goes from 1 to 4 as follows: 1=middle school completed, 2=Matric/O Level completed; 3=F.A./F.Sc./A Level completed; 4=B.A./B.Sc./B.Com/B.Ed level completed. Rate of health is another categorical variable ranging from 1 to 5 and the values correspond to the following questions: 1=very good; 2=good; 3=normal; 4=poor; 5=very poor. The limit of this variable is the answers come from a subjective point of view of each student because there was no doctor to check their health status. Level of internal locus of control is again a categorical variable and the students were expected to give a preference to the following statement: "I believe my chances of success depend on my own abilities". The variable ranges from 1 to 4 where: 1=agree strongly; 2=agree; 3=disagree; 4=disagree strongly.

Since we are interested in assessing the role of parental education on the level of religiosity of female students, we re-write Eqn. (1) in the following form:

$$Y_i^j = CM_i\beta_1 + P_i\beta_2 + Z_i\beta_3 + E_i\beta_4 + v_i. \quad (2)$$

The second equation has the same notation and specification of the first one except for the presence of the additional covariate E which is a categorical variable identifying the level of education of the father and mother of each female student[36]. In case of a positive and significant coefficient of the added variable, we can expect the presence of educated parents effect.

[36] The variable indicating the level of education of the mother and father is a categorical variable and it has the following values:
1= none, 2=primary, 3=middle, 4= matric/O Level,
5= FA/FSc/A-Levels, 6=BA/BSc/BCom/BEd, 6=MA/MSc/MCom/more; 7= professional.

Table 2 is a summary of the main characteristics of female students regarding personal attributes, household information, parental economic background and level of education. All given information is filtered according to the school type, either madrasa or secular. Most of the variables are dummies, three of them are categorical and continuous, as explained in note 1.

We can already see some main differences between madrasa and secular female students. The former live in an accommodation provided by the madrasa and have limited or no access to the television while the situation is reverse for college girls. Both groups seem to have, on average, almost the same level of education and rate of health as well as the dummy regarding the presence of any disability. Surprisingly madrasa students are more likely to have a higher level of internal locus of control though the difference is not so significant.

Table 2. Female students' main characteristics by school type

Variables	Madrasa			Secular		
	Mean	Std. dev.	N	Mean	Std. dev.	N
Personal characteristics and attitudes						
Live in an accommodation provided by the school	0.642	0.481	187	0.182	0.387	269
Female student level of education completed	2.574	0.805	195	2.491	0.536	277
# of hours spent per day watching tv	1.841	1.464	189	3.408	1.582	277
Presence of disability	0.005	0.072	194	0.003	0.060	277
Rate of health	2.386	0.852	194	2.563	0.901	277
Level of internal locus of control	1.936	0.897	189	1.712	0.635	274
Aspire have job on your own	0.830	0.376	171	0.792	0.406	270
Parental profile and economic background						
Mother alive	0.964	0.186	195	0.972	0.166	282
Father alive	0.933	0.250	195	0.911	0.284	282
1st, 2nd, 3rd..child of your parents	3.588	2.104	187	2.861	1.686	274
Father income	15382	14434	188	114394	561352	235
Father own any land	0.831	0.375	190	0.736	0.441	269
Father read newspaper	0.533	0.500	182	0.765	0.424	269
Level of religiosity						
Fasting during Ramadan	0.989	0.101	195	0.904	0.295	282
Donating sadaqa	0.961	0.192	183	0.901	0.299	263
Read translated Qur'an	0.118	0.323	195	0.330	0.471	282
Willing to allow your husband marry another wife	0.526	0.506	138	0.166	0.373	276

Source: own survey data.
Most of the data are dummies with the exception of level of education completed, # of hours spent watching tv per day, rate of health, level of locus of control, the number of child born corresponding to each girl interviewed in order inside the family, and father income. This last one is a continuous variable. The level of education completed has the following values:1=Middle school completed; 2=Matric/O Levels; 3= F.A./F.Sc./A Levels; 4=B.A./B.Sc./B.Com/B.Ed. The rate of health is rated as: 1= very good; 2=good; 3= normal; 4=poor; 5= very poor. The level of locus of control is rated according to the answer of the statement "I believe my chances of success depend on my own abilities" as follows: 1=agree strongly; 2=agree; 3=disagree; 4=disagree strongly.

Interesting differences and similarities are visible in parental profile and economic background of students from the two categories of educational institutions. Girls from both the madrasas as well as secular colleges generally have both parents alive but madrasa girls seem to have more elder siblings and record lower father income comparing to their counter parts in colleges. College girls on the average also have more fathers who read newspaper. When compared to students in colleges, madrasa girls seem to have a little higher level of religiosity as expressed through their responses to questions about fasting during Ramadan, giving sadaqa and having the willingness to allow their husband to marry another wife but a lower one in regard to reading translated Qur'an.

We are mostly interested in analysing the existence of a possible educated parental interaction effect on female students' level of religiosity. Table 3 (a and b) reports the marginal effects of the probit model for eight sets of regressions where the dependent variable is the level of religiosity measured through four questions on religiosity. The dependent variable is a binary result following the answers that female students gave to the following questions: "Do you fast during Ramadan?"; "Do you

regularly donate money under the form of sadaqa?"; "Have you read the Qur'an with translation?" and "Will you be willing to allow your husband to marry another wife?". The answer of the first question is either "occasionally", then the dependent variable takes the value of 0, or "always" therefore y is equal to 1. The answer of the second question is either positive, and in that case it takes the value of 1, or negative therefore the dependent variable is equal to 0. Regarding the third question, we consider as zero all the answers giving "no" or "some parts" as a response and 1 if the response was "the entire Qur'an". Finally, the last question is a simple dummy which takes the value of 1 for a positive answer or zero otherwise.

Table 3a. Probit model of determinants of students' characteristics and household profile towards level of religiosity measured with three different variables, with and without control for parental education (only marginal effects are listed)

	Fast during Ramadan		*Donate sadaqa*	
	(Eqn. 1)	(Eqn. 2)	(Eqn. 1)	(Eqn. 2)
Attended madrasa	**0.068***	**0.033**	**0.076***	**0.069**
	(0.036)	(0.031)	(0.039)	(0.042)
Level of mother education		-0.020**		0.005
		(0.009)		(0.006)
Level of father education		0.014*		-0.009
		(0.007)		(0.007)
N	298	293	283	278
Pseudo R^2	0.179	0.252	0.160	0.171

*Note: Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. Only marginal effects are listed.*
Source: own survey data.

Table 3b. Probit model of determinants of students' characteristics and household profile towards level of religiosity measured with three different variables, with and without control for parental education (only marginal effects are listed)

	Read translated Qur'an		***Allow your husband marry another wife***	
	(Eqn. 1)	(Eqn. 2)	(Eqn. 1)	(Eqn. 2)
Attended madrasa	**-0.175****	**-0.059**	**0.192***	**0.167**
	(0.075)	(0.088)	(0.102)	(0.120)
Level of mother education		0.001		-0.036*
		(0.021)		(0.021)
Level of father education		0.058***		0.037*
		(0.020)		(0.020)
N	275	271	230	228
Pseudo R^2	0.198	0.242	0.120	0.138

*Note: Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. Only marginal effects are listed.*
Source: own survey data.

Regression results reported in table 3a (column 1-2) explores the level of religiosity given by the question about fasting during Ramadan. In our specification, the key determinant is the variable related to madrasa attendance. After controlling for personal attitudes and household socio-economic background listed already in table 2 (which are not shown in table 3a and b for space constraint), we find that madrasa female students are almost 7% more likely to fast during Ramadan comparing to their secular school peers. However, as soon as we add two

covariates (column 2) related to the level of education of girls' parents, the madrasa effect disappears. The first column refers to equation 1 whereas the second column to equation 2 and so on and so forth for each of the following questions. An interesting result is that the higher is the level of mother education less likely is the probability of a girl to fast during Ramadan. However, the relationship runs in the opposite direction in case of educated father. It seems that a more educated mother allows the daughter greater degree of freedom in choosing which ritual practices to observe. More educated fathers, however, seem to encourage higher degree of religious observance within the household.

Almost the same pattern appears to hold also in the other two cases regarding donating sadaqa and the girls' being willing to allow their husband to have another wife. As soon as we control for the level of parents' education (see column 4 of table 3a and 3b), madrasa attendance loses significance but father education shows a positive relation with a girls' willingness to allow her husband to have another wife. In fact, in the fourth question, students are almost 4% more likely to allow their husband to have a second wife, the higher the level of father education (column 4 table 3b) while the opposite result with almost the same magnitude happens in the case of mothers with higher education. The results related to the second question ("Do you regularly donate money in the form of sadaqa?"), do not show any significance relationship to the parental level of education but, at the same time, once we control for parental level of education, madrasa attendance effect again disappears.

These results become even more interesting, when we see the answer to the third question aimed at measuring religiosity on

which there is a significant difference in response, 'Have you read the Qur'an with translation?' Since there is a negative sign in front of the estimate it means in case of this question we have a "college effect[37]" instead of "madrasa effect". Yet, again this school type effect disappears after controlling for parents' level of education. Further, the more educated the father is, almost 7% more likely is the female students in reading Qur'an with translation. When it comes to interpreting the significance of this question for an individual's level of religiosity, we should keep in mind that all the girls responded positively to reading the Qur'an in its original language namely Arabic. Thus, those who are trying to read the translated version in addition to the Arabic version are trying to understand its actual meaning more deeply by reading it in their mother tongue.

Summarizing the above results, according to equation 1, our results do report the existence of madrasa attendance effect or certain important dimensions of one's level of individual religiosity, however, this effect disappears when we control for parental education. There appears to be a distinct and significant correlation between parental education and female students' level of religiosity. It is especially evident through analysis of questions one (Do you fast during Ramadan) and question four (Will you be willing to allow your husband to marry another wife?). Our data shows that higher educated mothers are more supportive of breaking traditional mind set than the fathers.

[37] With college effect, we indicate that a difference in the level of religiosity between the two groups does exist and it is higher for college girls. This case, though, is very rare and it appears only for the question asking about reading the Qur'an with translation.

Gender development programs thus need to focus more targeted programmes towards changing the attitudes of the fathers.

3.6 Further controls

Our results are supported by a set of 16 regressions which represent our robustness checks; they are all summarized in table 4 (a and b) and 5 (a and b). We tried to add one and two variables to check whether the results given by the marginal effects still confirm our findings. Table 4a and 4b show eight regressions which are the same as the ones presented in the benchmark table (table 3a and 3b) with the only difference that, this time, we added one more variable concerning female students' desire or ambition: a dummy variable asking whether she has any aspiration of having a job on her own (where 1 corresponds to an affirmative answer and zero otherwise). Table 4a and 4b reports the results which are identified by the following equations:

$$Y_i^j = CM_i\beta_1 + P_i\beta_2 + Z_i\beta_3 + J_i\beta_4 + v_i\,, \quad (3)$$

$$Y_i^j = CM_i\beta_1 + P_i\beta_2 + Z_i\beta_3 + J_i\beta_4 + E_i\beta_5 + v_i^{38}. \quad (4)$$

Notation and specification of the above equations are the same as Eqn. (1) and (2); the only difference is the addition of the

[38] In this equation you can notice that Z is the same as the one in Eqn. (1 and 2) because it includes the same variables listed in table 3 related to family socio-economic background of female students. The same holds for P, as far as personal characteristics and attitudes variables of female students is concerned.

dummy J which identifies the aspiration of having a job on your own.

Table 5a and 5b represent another robustness check which differentiates from the previous table because, apart from the aspiration question, we have added another dummy variable: female students were asked whether their father reads newspaper (if positive then the variable assumes the value of 1, otherwise 0). The set of eight regressions have, therefore, another identification which slightly differs from the previous one as follows:

$$Y_i^j = CM_i\beta_1 + P_i\beta_2 + Z_i\beta_3 + J_i\beta_4 + N_i\beta_5 + v_i, \quad (5)$$

$$Y_i^j = CM_i\beta_1 + P_i\beta_2 + Z_i\beta_3 + J_i\beta_4 + N_i\beta_5 + E_i\beta_6 + v_i. \quad (6)$$

In this case, another variable (N) is added which reports the dummy related to the question about whether or not the girl's father reads a newspaper on daily basis.

For all the dimensions of religiosity analysed in table 4 and 5 (both a and b), madrasa effect disappears again as soon as we control for parental level of education and the level of significance is almost the same as for the ones in table 3a and 3b; "college effect" persists in question 3. Another interesting point to note is the repeated negative sign in front of mother's level of education; again, it confirms the fact that it is less likely that a higher educated mother has a positive effect on the level of religiosity of her daughter(s). On the other side, father level of education presents constantly a positive sign therefore a female student is 1% (in the case of fasting during Ramadan) or 4% (in the case of allowing your husband to marry another wife) more

likely to be more religious, in terms of practical actions, the higher the level of education of the father. In sum, the result that madrasa effect disappears once we control for parental level of education persists in all robustness checks.

Table 4a Rob. Check 1. More variables: aspire to have a job on your own (only marginal effects are listed)

	Y^1: Fast during Ramadan		***Y^2: Donate sadaqa***	
	(Eqn. 7)	(Eqn. 8)	(Eqn. 7)	(Eqn. 8)
Attended madrasa	0.066**	0.032	0.072*	0.06
	(0.032)	(0.027)	(0.038)	(0.039)
Level of mother education		-0.019**		0.003
		(0.009)		(0.005)
Level of father education		0.013*		-0.008
		(0.007)		(0.006)
Aspire to have a job on your own	-0.061*	-0.042*	-0.046	-0.041
	(0.036)	(0.025)	(0.037)	(0.036)
N	289	285	274	270
Pseudo R^2	0.203	0.277	0.182	0.196

Note: Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. Only marginal effects are listed.
Source: own survey data.

Table 4b Rob. Check 1. More variables: aspire to have a job on your own (only marginal effects are listed)

	Y^3: Read translated Qur'an		***Y^4: allow your husband marry another wife***	
	(Eqn. 7)	(Eqn. 8)	(Eqn. 7)	(Eqn. 8)
Attended madrasa	-0.179**	-0.043	0.187*	0.166
	(0.075)	(0.091)	(0.104)	(0.122)
Level of mother education		0.010		-0.036*
		(0.022)		(0.021)
Level of father education		0.056***		0.037*
		(0.020)		(0.020)
Aspire to have a job on your own	0.104	0.095	0.024	0.011
	(0.077)	(0.073)	(0.072)	(0.072)
N	266	263	227	225
Pseudo R^2	0.212	0.257	0.120	0.136

*Note: Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. Only marginal effects are listed.*
Source: own survey data.

Table 5a Rob. Check 2. More variables: aspire own job and father read news (only marginal effects are listed)

	Y¹: Fast during Ramadan		***Y²: Donate sadaqa***	
	(Eqn. 9)	(Eqn. 10)	(Eqn. 9)	(Eqn. 10)
Attended madrasa	0.075**	0.033	0.068*	0.059
	(0.030)	(0.024)	(0.039)	(0.038)
Level of mother education		-0.017**		0.003
		(0.008)		(0.005)
Level of father education		0.009		-0.008
		(0.006)		(0.007)
Aspire to have a job on your own	-0.060*	-0.038*	-0.044	-0.041
	(0.034)	(0.022)	(0.039)	(0.037)
Father read newspaper	0.038*	0.028*	-0.006	-0.000
	(0.021)	(0.017)	(0.016)	(0.016)
N	286	282	273	269
Pseudo R^2	0.231	0.309	0.184	0.197

*Note: Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. Only marginal effects are listed.*
Source: own survey data

Table 5b Rob. Check 2. More variables: aspire own job and father read news (only marginal effects are listed)

	Y^3: Read translated Qur'an		***Y^4: allow your husband marry another wife***	
	(Eqn. 9)	(Eqn. 10)	(Eqn. 9)	(Eqn. 10)
Attended madrasa	-0.152**	-0.045	0.185*	0.165
	(0.076)	(0.093)	(0.106)	(0.123)
Level of mother education		0.012		-0.035*
		(0.023)		(0.021)
Level of father education		0.047**		0.038*
		(0.021)		(0.021)
Aspire to have a job on your own	0.104	0.095	0.026	0.013
	(0.076)	(0.074)	(0.072)	(0.072)
Father read newspaper	0.160***	0.077	0.009	-0.016
	(0.061)	(0.064)	(0.061)	(0.066)
N	263	260	225	223
Pseudo R^2	0.233	0.261	0.120	0.135

*Note: Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. Only marginal effects are listed.*
Source: own survey data

3.7 Selection bias issue

The robustness checks just shown in the previous chapter, support, from one side, the robustness of the main results shown in table 3. On the other side, there is still another methodological concern that raises. Initially, in our study, the marginal effects of

our probit model show a difference between the level of religiosity of the two groups of students. Even though, this difference disappears once we control for mother and father level of education. This result might also indicate that parental education is at least equally or more relevant to the level of religiosity of female students than madrasa versus college education. The methodological concern is about the fact that there could be some form of selection bias or endogeneity bias due to the socio-economic differences among the two groups of students. In fact, the distribution of female students over categories could have been done in a selective way and not random. In fact, female student could have been enrolled to a madrasa instead of a secular school because of the will of very religious parents or because of socio-economic background or the way madrasa are perceived and valued by the society as a whole. The reasons can be different but all of them undermine the randomness of the survey. Although, aware of the fact that only an instrumental variable can solve this issue, we try to include the selection bias problem into the empirical specification through the estimation of the Heckman selection model (Heckman 1976, 1979).

Heckman selection model, which in our case corresponds to the two step estimation, includes two processes related to each other which are defined by two equations.

The first equation determining the sample selection is called the "selection equation" and it is the following (Greene, 2012):

$$Z_i = w'_i\gamma + u_{1i}$$

This is the equation for the probit estimates where "i" are the observations, "z" is the dummy variable arising the selection problem while "w" is the set of covariates explaining the dependent variable and "u" represents the error term. With our dataset, the selection equation corresponds to the following:

$$CM_i = X_i\beta_1 + E_i\beta_2 + v_i$$

Where "i" is an index identifying each student interviewed, "CM" is the dummy regarding the enrolment into a madrasa or a secular school. The independent variables are related to the socio-economic background of the female students available in the dataset (X): father income, a dummy whether the father own any land, the number of child among siblings, the level of mother and father education and a dummy on whether at least one of the parent can speak English. This last one is the variable that does not appear in the regression model. We added parents' level of education (E) because it is possible that it is correlated with the decision of sending their children to a madrasa or a secular school. This correlation could exist because, for example madrasa schools are located in places where mostly skilled people are living or because low educated people has been trained into a madrasa school and do not recognize any benefit of a further education.

The second equation of the Heckman selection model is the regression model or "regression equation":

$$Y_i = v'_i ß + u_{2i};$$

And the following has to hold:

$$u_1 \sim N(0,1)$$
$$u_2 \sim N(0,\sigma)$$
$$corr(u1,u2) = \varrho$$

Again, "i" identifies the observations, "Y" is the dependent variable of the model being analyzed while "v" is the set of explanatory variables and "u" is the error term.

Translated into our dataset, the regression equation corresponds to the following one:

$$Y_i^j = CM_i\beta_1 + P_i\beta_2 + Z_i\beta_3 + v_i$$

and

$$Y_i^j = CM_i\beta_1 + P_i\beta_2 + Z_i\beta_3 + E_i\beta_4 + v_i.$$

where "i" is an index identifying each student interviewed whereas "j" is an index indicating the number of the question related to the level of religiosity which corresponds to the dependent variable (j=1,2,3,4). The above equations are the same as equation 1 and 2, with and without parental education E[39]. In fact, the regression includes as a dependent variable the level of religiosity and the covariates are the same as the one listed in table 2.

Our model regression calculates unbiased estimates when $\varrho=0$ and biased otherwise. We suspect the existence of selection bias therefore the two above equations, the regression and the selection equation, are related to each other through the non-zero correlation between their error terms. Through Heckman

[39] To avoid repetition, the explanation of the variables is the same listed in equation 1 in chapter 3.5, the model.

selection model, we try to estimate consistent estimates for the parameters present in our model.

Our interest is mostly on the effects of the unmeasured characteristics of the surveyed female students on the choice of being enrolled on either a madrasa or a secular school. The coefficients of the explanatory variables cannot give this kind of information because it is not available but we can still obtain it through the residuals of the probit regression in the selection model. Thanks to them, it can be created a selection bias control factor called Lambda which corresponds to the Inverse Mill's Ratio (see also Guo, Shenyang, and Fraser, 2014). Lambda is a summarizing measure able to represent the effects of the unmeasured characteristics related to the enrolment decision. For this reason, lambda is added as an additional independent variable into the main equation because also the unmeasured characteristics effects are related to the level of religiosity. This is the process behind the creation of unbiased coefficient. The tables below show the results of the Heckman selection model:

Table 6a. Heckman selection model

	Eqn. 1	Eqn. 2	Eqn. 1	Eqn. 2
	Fast during Ramadan		***Donate sadaqa***	
Regression model				
Attending madrasa	0.089*	0.05	0.103**	0.099*
	(0.046)	(0.097)	(0.047)	(0.051)
Level of mother education		-0.042		0.006
		(0.034)		(0.019)
Level of father education		0.009		-0.008
		(0.029)		(0.013)
Constant	0.333*	0.286	0.812***	0.83***
	(0.186)	(0.368)	(0.169)	(0.171)
Select				
Father income	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Father own any land	-0.002	-0.002	0.229	0.229
	(0.217)	(0.217)	(0.3)	(0.3)
Number of child among siblings	0.005	0.005	0.000	0.000
	(0.051)	(0.051)	(0.079)	(0.079)
Level of mother education	-0.06	-0.06	-0.15	-0.15
	(0.063)	(0.063)	(0.103)	(0.103)
Level of father education	-0.061	-0.061	-0.037	-0.037
	(0.068)	(0.068)	(0.104)	(0.104)
Parent speak English	0.169	0.169	-0.121	-0.121
	(0.209)	(0.209)	(0.318)	(0.318)
Constant	1.368***	1.368***	2.343***	2.343***
	(0.379)	(0.379)	(0.596)	(0.596)
Rho	-0.147	1.00	0.304	0.316
Sigma	0.248	0.58	0.026	0.26
Mills				

Lambda	-0.037	0.58	0.079	0.082
	(0.266)	(0.993)	(0.324)	(0.67)
N	287	287	294	294

*Note: Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. Only marginal effects are listed.*
Source: own survey data.

Table 6b. Heckman selection model

	Eqn. 1	Eqn. 2	Eqn. 1	Eqn. 2
	Read translated Qur'an		***Marry another wife***	
Regression model				
Attending madrasa	-0.024	0.009	0.244**	0.224**
	(0.195)	(0.162)	(0.115)	(0.114)
Level of mother education		0.001		-0.026
		(0.053)		(0.024)
Level of father education		0.021		0.045**
		(0.046)		(0.021)
Constant	0.355	0.344	0.208	0.124
	(0.779)	(0.584)	(0.266)	(0.323)
Select				
Father income	0.000	0.000	0.000**	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)
Father own any land	-0.044	-0.044	-0.377	-0.377
	(0.222)	(0.222)	(0.255)	(0.255)
Number of child among siblings	-0.011	-0.011	-0.017	-0.017
	(0.051)	(0.052)	(0.051)	(0.051)
Level of mother education	-0.06	-0.06	0.281***	0.281***
	(0.065)	(0.065)	(0.072)	(0.072)
Level of father education	-0.063	-0.063	0.072	0.072
	(0.070)	(0.07)	(0.075)	(0.075)
Parent speak English	0.2	0.2	0.637***	0.638***
	(0.212)	(0.212)	(0.245)	(0.245)
Constant	1.432***	1.432***	-0.889**	-0.889**
	(0.387)	(0.387)	(0.376)	(0.376)
Rho	1.00	1.00	0.133	0.264
Sigma	1274	0.955	0.371	0.369
Mills				

Lambda	1274	0.955	0.05	0.097
	(1.238)	(1.382)	(0.094)	(0.153)
N	278	278	297	296

*Note: Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. Only marginal effects are listed.*
Source: own survey data.

One of the most important outcome of the table above is given by the value labeled as "lambda" (rho*sigma). In fact, the lambda coefficient, if significant, shows whether there is selection bias and what is its direction. In the case of a significant and positive coefficient, this would mean that the madrasa students compared to the secular ones, present unmeasured characteristics positively related to the level of religiosity. By looking at our table, though, lambda does not show any significance level.

Regarding the coefficients of the level of religiosity and parental education, they are always higher than the original model and this divergence might be due to selection bias issues. Moreover, only for the first level of religiosity, fasting during Ramadan, we can see that by adding parental level of education the significance of being enrolled into a madras or a college school disappears, therefor there is no madrasa effect. Another observation is that mother and father level of education is almost never significant, with the only exception of father education in the last case where female students were asked whether they agree their husband to marry another wife. In this case it is positive and it contributes in increasing the level of religiosity of their offsprings. There are indeed some caveats regarding our methodology. Though, even by adopting Heckman selection model, we are not able solve completely the problem of the

selection bias, which partially relates also to endogeneity. In fact, there still holds the doubt that those students enrolling into a madrasa are more likely to have a higher level of religiosity. Besides, we have to consider also measurement errors, which is quite possible due to the fact that we cannot actually check, for example, whether father income is actually what the father earns and maybe, the research assistant could have made a mistake while inserting the data into the computer or simply they might have misinterpreted some handwriting. Again, there can be many omitted variables which are supposed to be essential for our initial analysis on the level of religiosity. Unfortunately, the distance and the difficulty to communicate from abroad with the female students did not help to ask other important questions that could be added on the regression at the time when the study initiated. Another reason that drive to endogeneity is the simultaneous causality. The possible solution for this problem can be the use of an instrumental variable. One example can be the distance from the closest mosque from the place where the female students were living at the time of the interview. These data are not available for the moment, but if the budget constraint for the research in Pakistan can be overcome, this data can still be collected by the assistant researchers that every five years go to Pakistan for further interviews to the same female students as they try to keep track of them as much as they can along their life. Another solution can be that of adopting a quasi natural experiment for the identification by being cautious of possible internal validity concerns. Moreover, it would be interesting to deepen our research to understand the relevance of the "college effect" and to see if it shows a specific pattern as we have shown in case of "madrasa effect".

3.8 Conclusion

We contribute to that part of literature focused on the analyses of education and level of religiosity as well as parental influence on their offspring. We analyse female students attending either madrasa or secular colleges in urban area of Pakistan. Is it the level of religiosity affected by attending a madrasa or a secular school? And if so, does the level of parental education have any influence in that? Our results suggest that assumptions about madrasa attendance effect on student's level of religiosity in Pakistan are exaggerated. Apart from the fact that we found no significant difference between the levels of religiosity of madrasa girls as compared to those in modern colleges, our analysis shows that any differences in religious outlook are influenced not by religious school attendance but by a number of socio-economic differences in the profile of the two groups, most noticeably the difference in the level of education of their parents. Most importantly, our results demonstrate a strong effect of mother's education on a student's ability to exercise more progressive choices and exercise greater freedom to choose whether or not to undertake religious rituals or conform to conservative religious norms that can be confining of her agency, such as allowing a husband to have a second wife. Involving mothers in gender empowerment programs aimed at young girls is thus likely to prove an effective strategy. At the same time, the links that we have found between higher levels of fathers' education and increased religiosity in girls highlights the need to design interventions targeted directly at male family members to make them active agents in gender empowerment programs.

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Chapter 4

Catching-up Trajectories over Global Value Chains

4.1 Introduction

In the recent years, global production sharing has increased and has boosted trade in intermediate inputs. Researchers have focused their efforts in trying to develop new measures of trade, consistent with these changes. Another strand of research has started to consider persistent factors which are interconnected with output and trade performance, such as institutional quality.

In this work, we aim at providing an empirical contribution on these subjects, by trying to interpret the interdependence between production, input choices and specialization path. For this purpose, we stress the role of international sourcing of intermediates and labor force educational attainments on output performance. Moreover, we include economic and financial institutional quality along with traditional Heckscher-Ohlin factor endowments as sources of comparative advantage.

We find that there is a certain degree of substitutability between domestic and international sourcing of intermediate inputs as well as between labor force with different skill levels.

These findings suggest that the policy implications based on potential benefits of greater involvement in global supply chains may not be straightforward. Moreover, consistently with recent empirical studies, we find that there is a strong positive effect of both economic and financial institutions on specialization, controlling for traditional Heckscher-Ohlin determinants.

This work is organised as follows. Section 4.2 reviews the literature on the subject and the motivation related to the paper. Section 4.3 introduces the dataset. Section 4.4 describes the empirical specification and presents the findings and section 4.5 adds some robustness checks. Finally, section 4.6 concludes.

4.2 Motivation and Literature Review

This work adds to the recently growing literature on institutions as a further determinant of comparative advantage along with other traditional sources of international trade theory, in the light of the boost of trade in intermediate inputs and the emergence of global value chains. The theoretical literature has highlighted the relationship of interdependence between agents along a sequential production process and their specialization within the stage of the value chain (Costinot, 2012; Costinot et al, 2012). Additionally, Costinot (2009) suggests that the quality of labor force education and institutional characteristics are both relevant sources of specialization in the more complex industries. In this paper, we exploit these insights in two ways. First, we estimate a production function common to all the countries and sectors, in order to underline the contribution of labor specialization and international sourcing from abroad to country-sectoral output. Then, we assess the interdependence of

production and specialization pattern, considering the (economic and financial) institutional component. Hence, we attempt to generalize the interdependences between specialization patterns and production performances in a Heckscher-Ohlin framework with a globally common technology and emphasize the role of institutional quality as a determinant of comparative advantage. With respect to previous empirical studies, our focus is at the macro-level. We do this making use of a novel panel dataset at country-sector level and employing new appropriate measures of comparative advantage (Wang et al, 2013) to encompass the phenomena of global supply chains and trade in value-added[40]. Our findings confirm the relationship of dependence between specialization and production and the role of both economic and financial institutions as determinants of comparative advantage.

There are at least two strands of literature related to this paper. First, we explore this subject in the light of the growing interest of academics on the role of global value chains and the upsurge of trade in intermediate inputs and trade in value-added. Secondly, this work relates to the recently growing empirical and theoretical literature on the institutions as sources of comparative advantage.

The first strand of literature related to our work originates from the intensification of trade in intermediate goods, both among developed and less developed economies, due to the fragmentation and increase in complexity of production chains

[40] The concepts of trade in value added and value added in trade are made clear by Stehrer (2012).

globally. Over 10 years, between 1995 and 2006, trade in intermediate goods and services increased 6.2 % yearly while intermediated services increased 7% on a yearly average. Miroudot et al (2009) find that more than half of international trade is represented by intermediate goods and services, that are not consumed directly but are used as inputs in the subsequent production process. The growth rate of trade in intermediate is the same as that of trade in final goods. Therefore the shares of intermediate and final goods and services have remained basically constant. In the age of globalisation and increasing fragmentation of production processes worldwide, this stable ratio between trade in intermediates and final goods may be explained by the fact that the internationalisation of trade has boosted both flows at the same pace.

Our work is linked to the broader branch of research linking trade and development. Recent analysis include Taglioni and Wrinkler (2014), who discuss the effects of participation to global value chains in particular for businesses on development, and Zi (2014) who provides a theoretical framework. This work adds to the literature on the static and dynamic gains from trade through access to new imported intermediate goods, starting from Romer (1987) and Rivera-Batiz and Romer (1991). However, Koopman et al (2012) underline that the boost in intermediate trade renders standard trade statistics and measures less reliable and there is therefore need of a new framework which can capture the value flows embodied in trade. Their work is one of the first attempts to provide a common framework to decompose gross trade measures into value-added components with exact definitions and taking into account double counted items. Johnson and Noguera (2012) provide significant evidence of differences

between gross trade measures and novel value-added statistics in depicting bilateral production sharing relationships.

This novel approach has, of course, several implications like on the assessment of the comparative advantage, based on traditional gross trade figures. Wang et al (2013) propose a more comprehensive framework with respect to Koopman et al (2012) aimed at decomposing trade flows at the bilateral sector level into several value-added and double counted components. Therefore, they improve the well-known Balassa (1965)'s revealed comparative advantage index by taking into account forward-looking trade flows, that is domestic and international production sharing. In our work, Wang et al (2013)'s new revealed comparative advantage represents the main point of specialization path at country-sector level.

The second strand of literature related to this work relates to the interdependence between institutional quality and specialization pattern. The first empirical works on the impact of contracting institutions on comparative advantage are by Nunn (2007), which focuses on the hold-up problem, and by Levchenko (2007), which includes property rights in the definition of institutions. In the traditional model of contractual incompleteness (Williamson, 1985), the investments undertaken by a supplier of an input have a greater value within the relationship with the buyer of the input. Imperfect contract enforcement incentivizes the buyer to renegotiate the conditions of the agreement with the supplier. Under poor contract enforcement, the risk of hold-up by the input buyer renders production of the input supplier more costly and inefficient. Levchenko (2007) provides a general equilibrium model in which contract incompleteness is considered as an institutional

characteristic which varies across countries and sectors. In the model, the author implies that high quality contracting institutions are a source of comparative advantage in countries and sectors where the risk of hold-up is more prominent, that is where the relationship-specific investments are higher. Nunn (2007) is the first to define and measure contract intensities, that is the relationship-specific investment intensities of goods. Similarly, Acemoglu et al (2007) propose a theoretical framework which implies that differences in contracting institutions generates differences in comparative advantages. While many empirical studies focus on the impact of contracting institutions on horizontal specialization (across sectors), some study its impact on vertical specialization (Essaji and Fujiwara, 2012). While Nunn defines the concept of contract intensity, Levchenko instead defines institutional dependence. To sum up, there is already broad evidence that contracting institutions have an impact on trade and are a source of comparative advantage. Nunn and Trefler (2013) provide a rather extensive review of the empirical and theoretical literature on the relationship between institutions as a source of comparative advantage and international trade. The authors cite studies on different types of institutions affecting comparative advantage: contracting institutions, financial development institutions (Beck, 2003; Manova, 2008) and labor market institutions (Costinot, 2009). The empirical studies control for methodological problems such as omitted-variables bias and reverse causality. Institutions may be correlated with other country or industry characteristics (for instance, infrastructure) which have an impact on the specialization. In order to avoid the omitted-variables bias, the already cited empirical studies include fixed effects as well as

country-sector interaction terms and Heckscher-Ohlin factor endowments. On one hand, several types of institutions influence the specialization path in certain sectors; on the other hand, countries with a comparative advantage in institution-intensive industries are more incentivized to invest in the quality of those institutions. Among other studies, Nunn (2007) addresses the issue of reverse causality between institutional quality and country specialization in specific sectors with the use of legal origins as instrumental variable. Financial environment can affect the specialization pattern of a country in several ways. The theoretical studies on the effect of financial market on comparative advantage highlight the role of credit constraints and sector differences in investments costs. For instance, Beck (2002) finds that countries with better developed financial systems have a comparative advantage in sectors where fixed costs are higher, such as manufacturing. However, Beck does not deal with endogeneity issues in a convincing manner. Chor (2010) examines all the institutional explanations of previous studies simultaneously and finds that, despite the effect of each institutional explanatory variable on trade pattern is small, all the determinants are significant. The institutional determinants employed by Levchenko (2007) and Nunn (2007) are particularly relevant, even after controlling for traditional sources of comparative advantage in a Heckscher-Ohlin setup such as relative factor endowments.

In the light of the existing literature, our work has two main objectives. First, we estimate country-sector production function, by considering a shared common technology. Our objective is to emphasize the contribution of factor endowments and in particular that of different labor skills and of international

sourcing of intermediate inputs. The translog functional form allows us to estimate input substitutability, marginal returns and technological rate of change with a high degree of flexibility. Secondly, we investigate the channels through which specialization endogenously affects output performance. Along with traditional endowments determinants, economic and financial institutions are found to be relevant sources of comparative advantage and of the interdependence mechanism among specialization pattern, its determinants and production level.

4.3 Data and Descriptive Statistics

In this work, we mainly use three data sources for analysis: the World Input-Output Database (WIOD) which represents our basis, the Worldwide Governance Indicators (WGI) by Kaufmann et al (2009) and the Financial Development Indexes by the International Monetary Fund, where we source respectively economic and financial institution variables.

Firstly, we exploit the World Input-Output Database (WIOD) which is one of the most up-to-date set of Inter-Country Input-Output tables. It was created by a consortium of European research institutions and financially supported by the European Commission. Timmer et al. (2012) provide an extensive description of the WIOD database, its strengths and weaknesses, construction methods and sources. The dataset ranges from 1995 to 2011, it covers 40 countries worldwide and 35 sectors. By looking at the single columns of the yearly World Input Output Tables (WIOT), we can highlight the traded value contribution of

intermediate inputs on the gross output at country-sector level and distinguish between domestic production sharing, that is the gross trade value of intermediate inputs sourced from other sectors in the country, and the value of foreign sourcing of intermediate inputs from abroad.

In an additional section called Socio-economic Account, the WIOD also includes information on prices and quantities of factor inputs with country-industry data on employment (number of workers, wages and educational attainment), capital stocks, gross output and value added at current and constant prices at the industry level. The country-industry employment levels are broken up into three skill categories (high, medium and low) which follow the educational attainment classification of the International Standard Classification of Education (ISCED).

The WIOD also contains all the information on final consumption absorbed domestically and gross export. Following Wang et al. (2013), we calculate a new measure of trade specialization, in the light of a higher fragmentation of production processes. While Balassa's (1965) revealed comparative advantage (RCA) index is based on total gross exports, Wang et al.'s (2013) propose a new measure of revealed comparative advantage (NRCA, for short) which substitutes total gross exports with a forward-looking measure of domestic value added, derived from their disaggregated decomposition method of the WIOD gross exports.

Due to a large number of missing values, we consider only the WIOD up to 2009 and we exclude Taiwan from the analysis in order to overcome the issue of data availability, as different

sources do not always distinguish between China and Taiwan or do not have data specifically on Taiwan.

Secondly, we make use of the Worldwide Governance Indicators by Kaufmann et al (2009) employed by previous empirical studies as measures for institutional quality. The WGI is a panel dataset covering more than 200 countries since 1996 of six indicators of several dimensions of governance such as Voice and Accountability, Political Stability, Government Effectiveness, Regulatory Quality, Rule of Law and Control of Corruption. For the purpose of our analysis, we focus on one of the areas of WGI, that is the respect of citizens and the state for the institutions, and consider one specific variable, Rule of Law. Following the existing empirical literature, we use Rule of Law as a proxy for the quality of economic institutions. In particular, the WGI' Rule of Law measures perceptions of the agents with respect to contract enforcement, property rights, police, courts and the probability of violence and crime. For an extensive analysis of the construction of the indexes and the potential bias related to survey data, we refer you to Kaufman et al. (2011).

Thirdly, we include a recently developed dataset by the International Monetary Fund on financial development indicators covering 176 countries over the period between 1980 and 2013 (Sahay et al, 2015). We focus on financial institutions only, including both bank and nonbank institutions such as insurance firms, mutual and pensions funds and other organizations. The financial institution index is constructed on the basis of twelve measures, grouped into three categories, depth, access and efficiency. Each index is normalized between zero and one. We refer you to Sahay et al (2015) for deeper analysis of the construction methods of the index.

To sum up, our empirical study combines several still relatively unexploited data sources in the light of increasing importance of global value chains. The whole sample consists of 39 countries, 35 sectors over a time span of 15 years from 1995 to 2009. A more ample description of the data and the construction of the variables is provided in the appendix.

4.3.1 Descriptive Statistics

Table 1 provides summary statistics for the variables employed. Different country and year coverage are the reason why database sample sizes differ. There is considerable cross-country variation over the period considered and this is measured by the within-standard-deviation. The mean values reflect the fact that the sample consist mainly of developed economies, since WIOD includes mostly European countries.

Table 1. Summary statistics

Variable	Obs	Mean	Std. Dev.	Std. Dev. Within	Min	Max
Real Gross Output	20235	414.69	1302.37	318.68	0.00	22525.65
Capital	18950	66642.95	448422.20	78515.06	0.00	14100000.00
High-Skill Labor	20340	299.31	1192.33	337.78	0.00	32592.52
Medium-Skill Labor	20340	1068.23	5324.48	823.36	0.00	139872.40
Low-Skill Labor	20340	1447.83	18016.14	968.67	0.00	518911.20
Foreign inputs	19905	29.52	106.66	67.99	0.00	7771.90
Domestic inputs	19905	178.33	577.22	206.29	0.00	14104.41
Rule of Law	15015	0.88	0.82	0.11	-1.13	2.00
Rule of Law - distance from the mean	15015	0.00	0.82	0.11	-1.97	1.11
Financial Institutions	20475	0.60	0.20	0.10	0.05	0.97
Financial Institutions - distance from the mean	20475	0.00	0.18	0.06	-0.42	0.31

Table 2 gives pairwise correlation coefficients of the variables employed in the regressions. There is a strong correlation between real gross output and domestic inputs. This may be explained by the impact of domestic market size on participation in international production sharing. In fact, a large domestic market renders the country less dependable on foreign intermediates and more prone to sell the intermediate goods both internally and abroad (Kowalski et al, 2015). Medium-skill

labor force is correlated with both high-skill and low-skill employment and suggests some degree of complementarity between labor force with medium levels of education. The indicators of economic institutional quality (WGI Rule of Law) and financial institutions (IMF) are highly correlated with each other, as well as with their distance from the mean values.

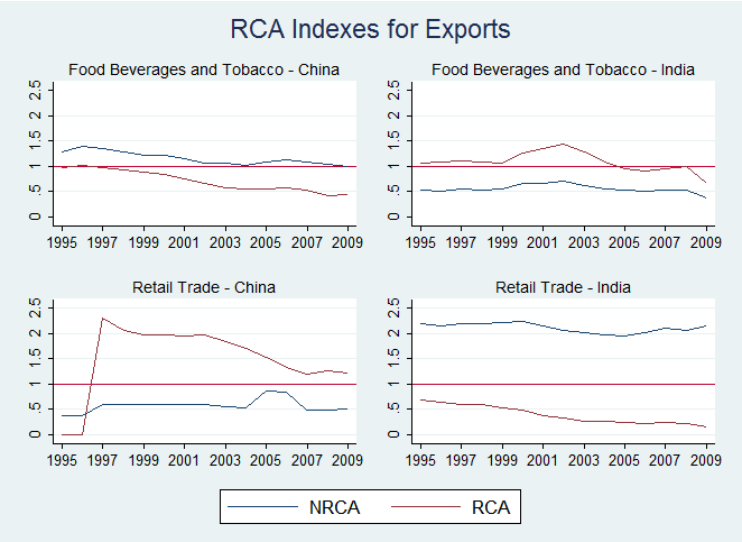
Table 2. Pairwise correlation

	Real Gross Output	Capital	High-Skill Labor	Medium-Skill Labor	Low-Skill Labor	Domestic inputs	Foreign inputs	Rule of Law	Rule of Law - distance from the mean	Financial Institutions	Financial Institutions - distance from the mean
Real Gross Output	1.00										
Capital	0.49	1.00									
High-Skill Labor	0.46	0.15	1.00								
Medium-Skill Labor	0.26	0.06	0.71	1.00							
Low-Skill Labor	0.08	0.01	0.22	0.61	1.00						
Domestic inputs	0.92	0.34	0.41	0.26	0.09	1.00					
Foreign inputs	0.44	0.09	0.15	0.11	0.03	0.56	1.00				
Rule of Law	0.11	0.08	-0.10	-0.17	-0.10	0.08	0.08	1.00			
Rule of Law - distance from the mean	0.11	0.08	-0.10	-0.17	-0.10	0.07	0.08	0.99	1.00		
Financial Institutions	0.16	0.09	-0.00	-0.04	-0.03	0.15	0.15	0.71	0.69	1.00	
Financial Institutions-distance from the mean	0.15	0.09	-0.02	-0.06	-0.04	0.14	0.13	0.76	0.76	0.92	1.00

We compare the traditional Balassa's RCA and the NRCA based on the value-added decomposition by Wang et al. (2013) of the WIOD. Following Want et al (2013), we provide two examples of how traditional and value-added measures of RCA can differ and lead to misleading conclusion. The food, beverages and tobacco sector in China presents a comparative disadvantage over the time span considered while, in India, the sector shows a comparative advantage. Using the novel index with forward-looking value-added measures, the revealed comparative export position of the two countries is reversed: China has a comparative advantage and India does not.

Conversely, the analysis of the NRCAs in sector of retail trade gives a brighter picture of the Indian market with respect to the Chinese market, while the old RCAs follow opposite path. Graph 1 provides a clear representation of the dynamics of the indexes of the 2 sector in the 2 Asian countries.

Graph 1 - RCA Indexes for Exports



RCA and NRCA indexes calculated for Chinese and Indian Sector 3 (Food Beverages and Tobacco) and Sector 21 (Retail Trade) using WIOD.

We will skip all the considerations about the magnitudes and the quantitative significance of both indexes but we will focus instead only on the qualitative property of signaling a revealed comparative advantage or disadvantage.

Table 3. Comparison between NRCA and RCA

	NRCA		
RCA	Disadvantage	Advantage	Total
Disadvantage	51.92	10.55	62.47
Advantage	5.06	32.46	37.53
Total	56.98	43.02	100

In more than 80 percent of the country-sectors over the time period under consideration, both measures are consistent with each other, that is either they both reveal a comparative advantage or a comparative disadvantage in the exporting sector of the country. However, the NRCA seems to overestimate more often a comparative advantage rather than underestimate a comparative disadvantage with respect to the traditional RCA. In fact, the share of observations when the NRCA is greater than 1 while the RCA is lower than 1 is almost twice the share of the opposite case (10.6 percent compared to 5.1 percent).

Table 4. Comparison RCA vs NRCA India and China

		CHINA				INDIA			
		average difference	*correlation*	*trend*	*comparative*	*average difference*	*correlation*	*trend*	*comparative*
c1	agriculture, hunting, forestry and fishing	*1.530*	*0.860*	down	A	*0.820*	*0.980*	down	A
c2	mining and quarrying	0.438	*0.898*	down	D	0.229	0.388	down	D
c3	food, beverages and tobacco	0.437	*0.937*	down	A	*0.513*	*0.950*	stable	D
c4	textiles and textiles products	0.175	*0.961*	down	A	*0.851*	*0.984*	down	A
c5	leather, leather and footwear	*0.621*	*0.989*	down	A	0.292	*0.989*	down	A
c6	wood and products of wood and cork	0.443	0.663	down-up	A	0.271	0.527	down-up	A-D-A
c7	pulp, paper, printing and publishing	0.445	**-0.56**	up	D	0.161	*0.950*	down	D
c8	coke, refined petroleum and nuclear fuel	*0.579*	*0.788*	down	D	0.278	*0.953*	up-down	D-A
c9	chemicals and chemical products	0.489	*0.771*	stable	A=D	0.079	*0.892*	up-down	D-A-D
c10	rubber and plastics	0.184	*0.776*	up-down-up	A	0.354	**-0.078**	up	D
c11	other non-metallic mineral	0.427	*0.939*	down	A	*1.456*	*0.995*	down	A
c12	basic metals and fabricated metal	0.207	**-0.66**	up	A	0.203	0.624	stable	D
c13	machinery, nec	0.194	*0.980*	up	D-A	0.039	*0.839*	up	D
c14	electrical and optical equipment	0.462	*0.970*	up	A	0.034	*0.993*	up	D
c15	transport equipment	0.127	*0.969*	up	D	0.017	*0.996*	up	D
c16	manufacturing, nec, recycling	0.064	*0.946*	up-down-up	A	*2.057*	*0.953*	up	A
c17	electricity, gas and water supply	*0.950*	**-0.63**	up	A	*1.358*	**-0.785**	down	A-D
c18	construction	*0.897*	0.103	stable	D	*1.600*	**-0.135**	up	A

				(down)					
c19	sale, maintenance and repair of motor vehicles retail sale of fuel	0.000				0.472	**-0.670**	stable	D
c20	wholesale trade and commission trade, except of motor vehicles	0.435	*0.896*	up-down-up	D-A-D-A	0.466	**-0.903**	up	D
c21	retail trade, except of motor vehicles; repair of household goods	*1.243*	0.477	up	D	*1.740*	0.062	stable	A
c22	hotels and restaurants	0.435	*0.953*	down	A	*2.733*	*0.971*	up	A
c23	inland transport	*0.566*	0.468	down	A	0.328	*0.812*	up-down-up	A
c24	water transport	*0.583*	*0.910*	up	D-A	0.123	*0.941*	down	D
c25	air transport	0.198	0.470	up-down-up	D-A-D	0.174	0.351	stable (down)	D
c26	other supporting and auxiliary transport activities, activities of travel agencies	0.328	*0.982*	down	D	0.198	*0.902*	stable (down)	D
c27	post and telecommunications	0.181	0.032	up	D-A	*0.546*	*0.857*	up	D-A
c28	financial intermediation	*0.671*	0.733	down-up	D	*0.916*	*0.897*	stable (up)	A
c29	real estate activities	*0.508*	**-0.01**	down-up	D	*3.435*	*0.983*	stable (up-down)	A-D
c30	renting of M&Eq and other business activities	0.206	*0.916*	up	D	*1.009*	*0.992*	up	D-A
c31	public admin and defence; compulsory social security	0.160	0.019	stable (up)	D	0.000			
c32	education	0.244	0.328	up-down-up	D	0.228	**-0.218**	up	D
c33	health and social work	*0.664*	**-0.30**	up	D-A	0.397		up	D
c34	other community, social and personal services	*1.011*	0.717	up-down	D-A-D	*0.916*	**-0.107**	stable (up)	A
c35	private households with employed persons	0.000				*37.917*	**-0.120**	stable (up)	A

Legend:
Average difference: if > 0.49 (italic numbers), big difference between RCA and NRCA;
Correlation: if > 0.75 (italic numbers), high correlation while if bold numbers, negative correlation;
Comparative: A=Advantage, D=Disadvantage.

The dataset presented in table 4 shows in details the difference between NRCA and RCA. The first column is the average difference between NRCA and RCA along all the years available. The second column shows the level of correlation between the two while the column called trend represents the development of the country into consideration along the years regarding the evolution of the new method of calculation, NRCA. The last column identifies the presence of a comparative advantage or disadvantage in the case of NRCA only.

4.4 Empirical Strategy

4.4.1 Baseline Results

Our aim is to analyse the effect on a global scale of trade in intermediate inputs on output at country-sector level and how international sourcing of input factor interacts with specialization.

For the purpose of our analysis, we adopt a production function as a starting point since it is both the basis of modern growth accounting and a straightforward way to link the simultaneous impact of multiple inputs to the industry aggregate output level. We deal with macro data, more precisely

39 countries around the world and each country presents data about 35 industries[41]. The time interval covers the period that goes from 1995 to 2009.

Among all the different functional forms, we choose the transcendental logarithmic (translog) production function as the most appropriate for our objective. The translog function can be interpreted as a generalization of the Cobb-Douglas production function and has been widely used empirically for its simplicity and great flexibility. Unlike the Cobb-Douglas production function, it imposes no a priori restrictions on the structure of technology and it is not claimed any restriction regarding elasticities of substitution and returns to scale (Kim, 1992). The limitations of those restrictions highly increase whenever the number of factors of production is more than two, as proved by Uzawa (1962) and McFadden (1963).

This functional form allows us to estimate the effect of several input factors on the aggregate industry output level, assuming a homogenous technology common to all countries and sectors, still with a high degree of approximation.

The form of the translog function is the following:

$$\ln Y_{ckt} = \alpha_0 + \sum_i \alpha_i \ln X^i_{ckt} + \delta_T T + \frac{1}{2}\sum_i \sum_j \beta_{ij} \ln X^i_{ckt} \ln X^j_{ckt} + \sum_i \gamma_{iT} \ln X^i_{ckt} T + 1/2\,\delta_{TT} T^2 + \varepsilon_{ckt}$$

[41] It should be more precise to consider the data as meso data instead of simply macro data. Even though this notation does not affect the methodology both meso and macro data use the same econometric technique. Besides, in the literature this notation is not important.

where Y_{ckt} is real value of gross output, $X_{ckt}^{i,j}$ are factors of production and T is the time trend adopted for the identification of technical change. The subscripts, c, k and t, identify respectively the country, the sector and the year while the superscripts, i and j, identifies the several input factor covariates. We are considering: real capital, total hours worked by three skill categories of labor force (high, medium and low-skill workers), domestic and foreign intermediates. Finally, ε_{ckt} represents the error term.

We include intermediate inputs, divided into domestic and foreign, among the production factors. Domestic intermediate inputs are generated by the trade among industries within the same country while foreign intermediate inputs are all the imported production factors. The latter are relevant because they capture offshoring and outsourcing activities and represent the connection with international trade as a driver of growth.

Previous empirical literature has emphasized different channels through which trade in intermediates can affect economic performance. Various trade and endogenous growth models, such as Romer (1987), incorporate foreign intermediate inputs and argue that access to new imported inputs is an important source of both static and dynamic gains.

A greater availability of input types generates gains in productivity in the short term and economic growth is stimulated in the long-run by the creation of new varieties domestically.

There are different ways how intermediate imports can affect economic outcomes. The first is the complementarity channel. By increasing the variety of inputs used in the production process,

economic agents can benefit from larger complementarity between them. Complementarity stems from imperfect substitutability among intermediate inputs as in the love-of-variety model of Krugman (1979) and refers to the idea that the combination of different intermediate inputs can create gains that are larger than the sum of the parts (Halpern et al, 2015). Empirical studies such as those of Fenstra (1994) and Broda an Weinstein (2006) document the gains from trade deriving from new imported varieties in the total volume of trade. Jones (2011) provides a theoretical contribution to explain how intermediate inputs are relevant for economic development and how they can drive large income differences across countries. He supports a long-standing approach in development economics that complementarities effect along different stages of the supply chain are crucial driver for output and economic growth (Hirschman, 1958).

Economic growth is also fostered by international trade through the transfer of foreign technologies integrated in high-quality intermediate imports and learning spillovers. A further benefit deriving from access to international sourcing of intermediates consists of input cost effect and enhanced competitiveness.

We test the static relationship between trade in intermediates and growth by estimating the nonlinear separable and joint effects of domestic and imported intermediates on output in a flexible way thanks to the translog specification. Our focus is on the complementarity channel between internationally sourced and domestically produced inputs and the mechanisms already described in literature (love of variety; technological spillover, access to cheaper inputs).

The specification of three different levels of skills for labor as explanatory variables allows the detection of nonlinear relationships with output and complementarity or substitutability in effects among the labor cohorts.

Despite many models based on Cobb-Douglas production function assume perfect labor-labor substitutability, empirical evidence, such as in the work by Autor et al (1998), suggests that workers with different skill levels are less than perfect substitutes.

Skill and factor biased technological change and international outsourcing, that is import of intermediate inputs from abroad, are seen as major factors contributing to labor demand shifts in favor of more educated workers (among others see Feenstra and Hanson, 1996; Acemoglu and Autor, 2011). They are also considered to play a central role in reshaping the job structure towards the so-called polarization trend. Job polarization refers to the phenomenon of decline in middle-skill employment in favour of higher- and lower skill positions (Autor, et al.,2006).

Horgos (2011) underlines the role of elasticity of substitution among labor force with different skills in the relationship between outsourcing and labor demand shifts: the higher it is, the larger the effect of outsourcing, similarly to technological progress, on employment disruptions.

These static labor-labor relationships with growth may be harmful for employment creation if, for instance, substitutability in effects between high and low skill workers means that a smaller number of workers is necessary to produce the same amount of output.

The translog production function does not impose any assumptions about the market structure and input factor

substitutability. Restrictive models will produce biased estimated compared to the nonhomothetic model (Kim, 1992). Therefore it provides a more flexible characterization of the model.

From a theoretical standpoint, the translog production function is considered to be extremely flexible because it allows to analyze both the direct and indirect effects of explanatory variables through the quadratic and interaction terms. More specifically, the presence of quadratic terms allow for non-linear relationship between the input factors and the output level while the interaction terms also allow for analysis of substitutability and complementarity in effects.

According to the equation describing the translog function, the model consists of 36 explanatory variables: apart from the intercept and the 7 linear covariates, we have a set of 21 interacted variable terms and 7 quadratic terms.

A noteworthy variable is the time trend, T, for the identification of the technical change. The rate of technical change is calculated as the elasticity of output with respect to time. The formula is the following:

$$\partial \ln Y_{ckt}/\partial T = \delta_T + \delta_{TT}T + \sum_x \gamma_{xT} \ln X_{ckt}$$

The rate of technical change is dependent on the level of input used and is both time and country-sector specific. Technological progress (or regress) as well as regulation changes may affect the sign of the rate of technical change.

The rate of technical change can be split into two effects (Wylie, 1990): the first two terms of the above equation represent the pure or autonomous effect of technology per se, which is a

neutral shift on the production independent on input factors; the last term represent the biased technical change which shows its effects through the use of various inputs.

The first results of the worldwide translog production function with a panel fixed effect estimation are shown in table 6, column 2 Base, in the appendix B section.

Out of 36 coefficients, 27 are statistically significant. The variables of capital and its interactions with high and low-skill workers, the interaction terms between labor groups and intermediate inputs with the exception of that between medium-skill-labor and domestic intermediate input are all non-significant.

The coefficients of the sets of variables describe three main effects. The sign and magnitude of the input covariates coefficients show the linear effect on the dependent variable, that is real gross output. The interaction terms depict the existence of a substitution effect or a complementary effect among the variables taken in consideration and in accordance with the sign of the coefficient, respectively negative or positive. Finally, the quadratic variables coefficients suggest the existence of a non-linear effect on output, either increasing or decreasing depending on the sign, respectively positive or negative.

Despite the single parameters of a translog function are not easily interpretable, the coefficients of the interaction terms in our estimation present both positive and negative signs, therefore they suggest the presence of both complementarity or substitutability in effects between the two interacted variables, independently of the other direct and indirect effects through other variables.

We mainly focus our analysis on the results regarding the joint effects of the intermediate input variables and the labor cohorts by skill level.

The negative coefficients of the interaction term between imported and domestic intermediates indicates the presence of a substitution in input effects on growth. Ignoring the direct effects of the inputs and their interactions with other production factors, the combined impact of foreign sourced and domestic intermediates is negative on output.

This result adds up to the findings on complementarity channels of trade in intermediates and economic performance. When disentangled from other effects, the simple interaction between intermediate input endowments sourced domestically and from abroad affects output negatively. For instance, substitutability in effects means that an increase in the import of foreign intermediates, due to international outsourcing and offshoring activities, generates a reduction in output through the interaction with those sourced from the domestic market.

Static and dynamic complementarities effects deriving from combing imperfectly substitutable domestic and foreign input varieties in production may be more than counterbalanced by economic gains due to replacement of cheaper and higher quality intermediate inputs from abroad and shared supplier spillovers from domestic firms (Kee, 2015).

All the parameters of the interaction terms among the three different skill levels are highly statistically significant. The coefficients of the interaction between the high-skill and low-skill labor force is negative while the parameters relative to the interactions of the medium-skill labor with the other two labor groups are positive.

Overlooking the impact of the other parameters, substitution in effects between workforce with high and low educational attainments is consistent with some degree of imperfect interchangeability among the groups.

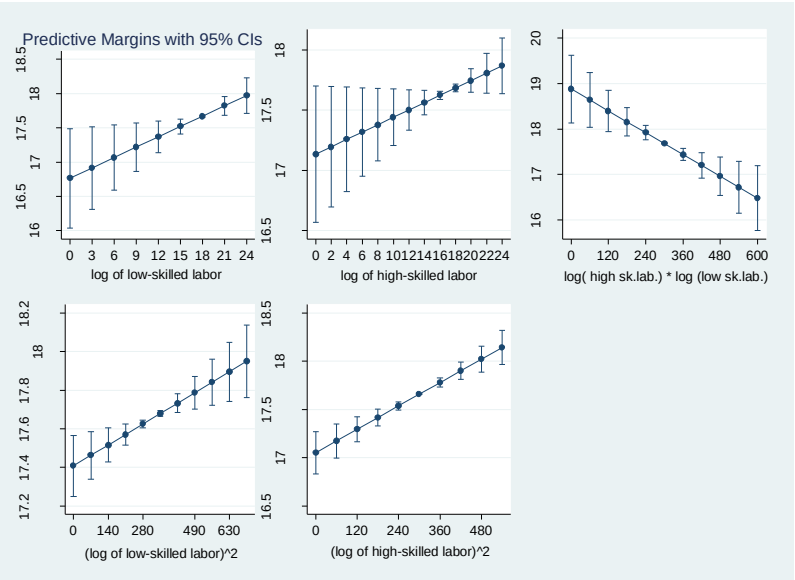
The estimates of joint labor variable terms imply that the workers skill distribution affects economic growth. The acceleration during recession of phenomena in the global labor market such as job polarization (that is the decline of middle-skill occupations in favour of higher and lower skill employment) and crowding-out of less educated are consistent with the signs of the coefficients in our estimation.

This finding supports policies with the intent to counteract the downsides of unequal skill distribution and its impact on employment and economic growth.

Another piece of information that can be extrapolated from the translog functional form of the worldwide production function is the existence of positive or negative non-linear effects. All of the quadratic terms coefficients are positive, demonstrating, therefore, the presence of positive nonlinear relationship between factor inputs and output. This means that the increase in one of the inputs, ceteris paribus, leads to an increase of the marginal outputs. Irrespectively of the level of other factor endowments of a country, an increase of one of the input, such as capital, will generate an increase of the marginal output at any starting point.

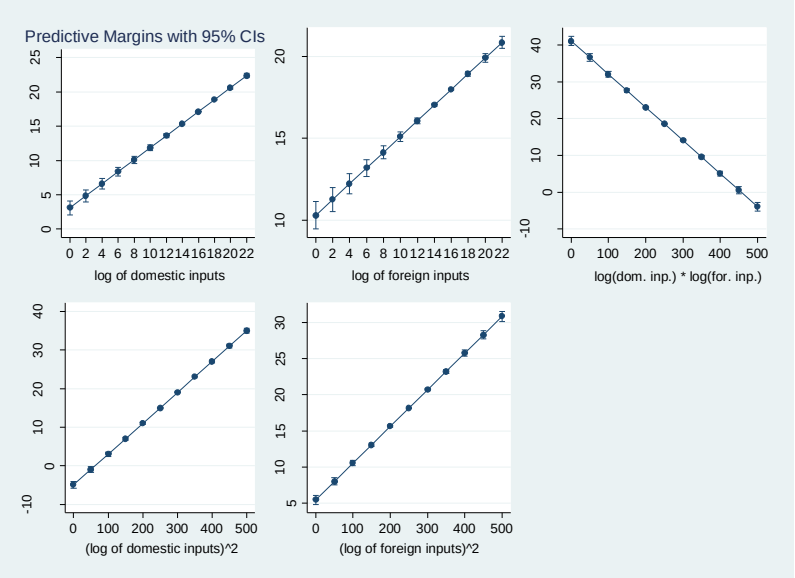
The evidence of substitutability, complementarity and non-linarites in effects can be better shown by the graphs of the marginal effects of the variable analysed.

Graph 2. Marginal Effect for High and Low-skilled workers



Predictive margins of high- and low-skill labor at average values of other inputs using baseline estimation of the translog production function Table 6 – Column I (18881 observations 39 countries, 35 sectors, 15 years)

Graph 3. Marginal Effect for Domestic and Foreign inputs



Predictive margins of domestic and foreign intermediates at average values of other inputs using baseline estimation of the translog production function Table 6 – Column I (18881 observations 39 countries, 35 sectors, 15 years)

Graph 2 and graph 3 in the annex section show the effect of the quadratic and interaction terms of the high-skill and low-skill labor variables and the foreign and domestic intermediate input factors. The marginal effects are shown at specific points within a confidence interval of 95%.

The graphs illustrates the marginal effect of each single variable, first, and then of the squared variable and finally the interaction term. The marginal effect of the single variable reveals whether there is an increasing or a decreasing effect due

to an increase of that precise variable that is being analysed, disregarding scale and interaction effects. All the single variables show a positive linear prediction for each increasing input level, reflecting the results given in the regression as well. The marginal effect of the quadratic term of all the variables confirm the presence of increasing marginal returns and the marginal effect of the two interaction terms mentioned before has a negative slope, illustrating, therefore, the existence of a substitution effect between the two variables considered.

The results relative to the single variable are mostly positive with three exceptions: capital, medium-skilled workers and time trend, which show a negative sign instead. The sign is showing whether the effect of a marginal increase in each input, keeping fixed all the others, will cause an increase or a decrease in the real gross output, our dependent variable, not considering potential nonlinearities and complementarities with other factors in effects.

Furthermore, we have computed the logarithmic marginal products, that is the output elasticities of the inputs, and the technical change rate. Each elasticity and technical change rate is computed at the mean, median and 75th percentile values of each variable. Table 5 reports all the input elasticities and the rate of technical change. For each, we isolate the autonomous effect and the biased effects.

Table 5. Output elasticities

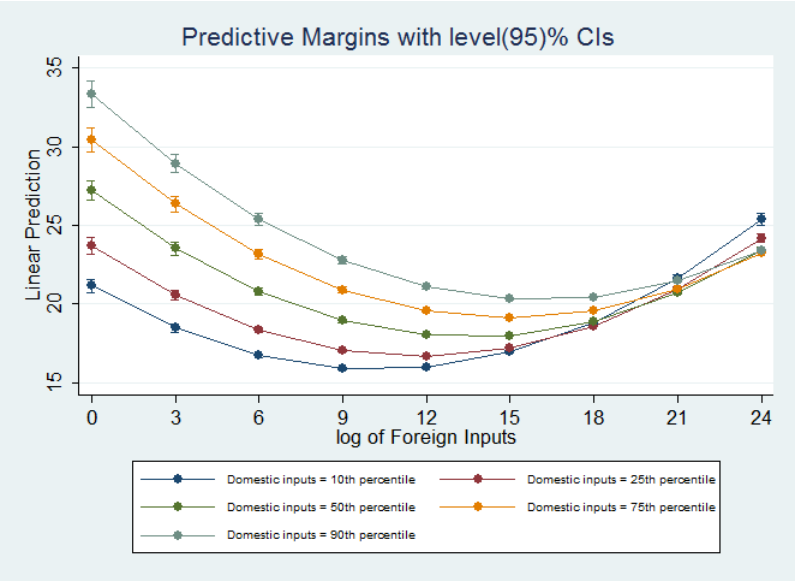
Output Elasticities at the population mean values					
	Direct Effect	*Quadratic Effect*	*Autonomous effect*	*Biased Effect*	Total
Capital	-0.0125	0.2878	0.2753	-0.3085	-0.0331
High-Skill Labor	0.0305	0.0345	0.0650	-0.0536	0.0114
Medium-Skill Labor	-0.1377	-0.1754	-0.3131	0.4397	0.1267
Low-Skill Labor	0.0503	0.0137	0.0640	-0.0505	0.0136
Domestic Inputs	0.8774	1.3286	2.2059	-3.0278	-0.8219
Foreign Inputs	0.4803	0.7768	1.2571	-1.8280	-0.5708
Technical Change Rate	-0.0183	0.0017	-0.0166	0.0093	-0.0073
Output Elasticities at the population median values					
	Direct Effect	*Quadratic Effect*	*Autonomous effect*	*Biased Effect*	Total
Capital	-0.0125	0.2905	0.2780	-0.3242	-0.0462
High-Skill Labor	0.0305	0.0345	0.0650	-0.0542	0.0109
Medium-Skill Labor	-0.1377	-0.1759	-0.3136	0.4384	0.1248
Low-Skill Labor	0.0503	0.0137	0.0641	-0.0512	0.0128
Domestic Inputs	0.8774	1.3519	2.2293	-3.0628	-0.8335
Foreign Inputs	0.4803	0.7901	1.2705	-1.8561	-0.5857
Technical Change Rate	-0.0183	0.0018	-0.0165	0.0097	-0.0068
Output Elasticities at the population 75th percentile values					
	Direct Effect	*Quadratic Effect*	*Autonomous effect*	*Biased Effect*	Total
Capital	-0.0125	0.3113	0.2988	-0.3631	-0.0643
High-Skill Labor	0.0305	0.0381	0.0687	-0.0598	0.0088
Medium-Skill Labor	-0.1377	-0.1908	-0.3285	0.4644	0.1359
Low-Skill Labor	0.0503	0.0150	0.0654	-0.0579	0.0074
Domestic Inputs	0.8774	1.4774	2.3547	-3.3039	-0.9492
Foreign Inputs	0.4803	0.8564	1.3368	-2.0195	-0.6828
Technical Change Rate	-0.0183	0.0024	-0.0159	0.0108	-0.0050

Apart from the medium-skill labor input which shows a divergent effect pattern, all the input autonomous effects are positive while the interacted effects are negative at the average, median and 75th percentile values of the population considered for the estimation.

Similarly to the medium skill workforce variable, the rate of technical change computed shows a negative autonomous effect and a positive biased technical change, mainly driven by the effect of the interaction with intermediate imports.

A visual representation of the autonomous and biased effects is given by the example in graph 4. It shows the nonlinear effect of imported intermediate inputs on real gross output at five different levels of domestic intermediate market size, controlling for the average values of the other inputs. In all cases, the impact of foreign intermediates is non-linear and positive only after a certain point. However, the gap between the effects at different levels of domestic inputs shrinks along with greater sourcing of intermediates from abroad and eventually the impact of intensification in international sourcing overwhelms the impact of combination of both. This corroborates the idea that complementarity channels between intermediates are overcome by substitutability in effect if the level of sourcing from abroad is over a certain threshold.

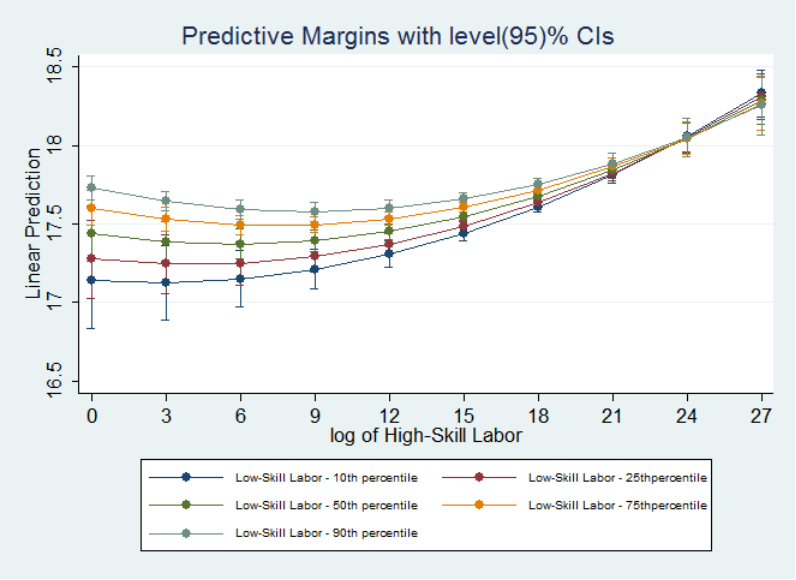
Graph 4. Marginal effect of foreign intermediate inputs



Predictive margins of foreign intermediates at percentile values of domestic intermediates and at average values of other inputs using baseline estimation of the translog production function Table 6 – Column I (18881 observations 39 countries, 35 sectors, 15 years).

Analogously, the relative impact of increasing highly skilled workforce with respect to low-skilled labor is diminishing, as shown in graph 5. However, substitutability in effects shows up only for high levels of endowment of both labor groups. This implies that country-sector size may have a role in skill distribution and their complementarity in effects.

Graph 5 - Marginal effect of high-skill labor



Predictive margins of high-skill labor at percentile values of low-skill labor and at average values of other inputs using baseline estimation of the translog production function Table 6 – Column I (18881 observations 39 countries, 35 sectors, 15 years).

4.4.2 Endogenous Treatment with New Revealed Comparative Advantage

In accordance with the theory, we tried to explain which are the variables that influence and affect the world output. We adopt inputs and intermediate goods as our best explanatory variables and we improve the literature by taking advantage of WIOD dataset therefore we use three different labor-skills for the workers and domestic and foreign inputs as intermediate goods.

Even though, we should consider the fact that WIOD presents some measurement errors[42]. Besides, the results that we can see in Table 6 column 1, show, overall, a strong correlation between inputs and worldwide output, but this is not enough to infer causality. In fact, there can be many omitted determinants of world output that can be correlated with inputs or intermediate goods. This problem may introduce a positive bias in the OLS estimates. Even though, there are many methods that can overcome the problem of omitted variable bias and one of those is instrumental variable, for instance, therefore we should find a good instrument for intermediate goods. Actually, we decided to solve this problem differently.

Table 6. Production function in translog and simultaneous

	Baseline	Treatreg I	Treatreg II	Treatreg III	Treatreg IV	Treatreg V	Treatreg VI
Capital	-0.0125	-0.0163	0.00920	0.00922	-0.0154	-0.0152	0.00919
	(0.0135)	(0.0130)	(0.0142)	(0.0142)	(0.0130)	(0.0130)	(0.0142)
High-Skilled Labor	0.0305*	0.0415**	0.0285	0.0285	0.0411**	0.0411**	0.0285
	(0.0170)	(0.0161)	(0.0192)	(0.0192)	(0.0161)	(0.0161)	(0.0192)
Medium-Skilled Labor	-0.138***	-0.123***	-0.112***	-0.112***	-0.124***	-0.125***	-0.112***
	(0.0266)	(0.0260)	(0.0303)	(0.0303)	(0.0260)	(0.0260)	(0.0303)
Low-Skilled Labor	0.0503**	0.0560**	0.0500*	0.0501*	0.0567**	0.0576***	0.0500*
	(0.0209)	(0.0223)	(0.0257)	(0.0257)	(0.0223)	(0.0222)	(0.0257)
Domestic Inputs	0.877***	0.689***	0.702***	0.702***	0.687***	0.687***	0.702***
	(0.0309)	(0.0290)	(0.0344)	(0.0344)	(0.0290)	(0.0290)	(0.0344)
Foreign Inputs	0.480***	0.521***	0.535***	0.535***	0.523***	0.524***	0.535***
	(0.0283)	(0.0263)	(0.0305)	(0.0305)	(0.0263)	(0.0263)	(0.0305)
Time	-0.018***	-0.034***	-0.038***	-0.038***	-0.034***	-0.034***	-0.038***

42 In fact, surprisingly, there are some negative intermediate inputs. This does not have any economic meaning but these values exist in order to balance the WIOD dataset as a whole because it is supposed to be a closed account.

	(0.00221)	(0.00250)	(0.00313)	(0.00313)	(0.00250)	(0.00250)	(0.00313)
Substitutability and Complementarity effects							
Capital*High-Skilled-Labor	-0.00248	-0.005***	-0.005***	-0.005***	-0.005***	-0.005***	-0.005***
	(0.00171)	(0.00168)	(0.00200)	(0.00200)	(0.00168)	(0.00168)	(0.00200)
Capital*Medium-Skilled-Labor	0.0404***	0.0299***	0.0318***	0.0318***	0.0299***	0.0300***	0.0318***
	(0.00206)	(0.00200)	(0.00239)	(0.00239)	(0.00200)	(0.00200)	(0.00239)
Capital*Low-Skilled-Labor	-0.00115	-0.007***	-0.009***	-0.009***	-0.007***	-0.007***	-0.009***
	(0.00123)	(0.00120)	(0.00150)	(0.00150)	(0.00120)	(0.00120)	(0.00150)
Capital*Domestic Inputs	-0.048***	-0.023***	-0.024***	-0.024***	-0.023***	-0.023***	-0.024***
	(0.00194)	(0.00218)	(0.00265)	(0.00265)	(0.00218)	(0.00218)	(0.00265)
Capital*Foreign Inputs	-0.011***	-0.008***	-0.007***	-0.007***	-0.008***	-0.008***	-0.007***
	(0.00166)	(0.00162)	(0.00189)	(0.00189)	(0.00162)	(0.00162)	(0.00189)
Capital*Time	-0.002***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***
	(0.000174)	(0.000182)	(0.000225)	(0.000225)	(0.000182)	(0.000182)	(0.000225)
High-Skilled Labor*Medium-Skilled Labor	0.0037***	0.00243*	0.000923	0.000925	0.00244*	0.00248*	0.000922
	(0.00139)	(0.00132)	(0.00149)	(0.00149)	(0.00131)	(0.00131)	(0.00149)
High-Skilled Labor*Low-Skilled Labor	-0.004***	-0.003***	-0.00261*	-0.00261*	-0.003***	-0.004***	-0.00261*
	(0.00124)	(0.00119)	(0.00135)	(0.00135)	(0.00119)	(0.00119)	(0.00135)
High-Skilled Labor*Domestic Inputs	0.00313	0.0119***	0.0138***	0.0138***	0.0118***	0.0118***	0.0138***
	(0.00234)	(0.00223)	(0.00260)	(0.00260)	(0.00222)	(0.00222)	(0.00260)
High-Skilled Labor*Foreign Inputs	-0.00280	-0.008***	-0.009***	-0.009***	-0.008***	-0.008***	-0.009***
	(0.00218)	(0.00202)	(0.00228)	(0.00228)	(0.00202)	(0.00202)	(0.00228)
High-Skilled Labor*Time	-0.001***	-0.001***	-0.0004**	-0.0004**	-0.001***	-0.001***	-0.0004**
	(0.000145)	(0.000138)	(0.000165)	(0.000165)	(0.000138)	(0.000138)	(0.000165)
Medium-Skilled Labor*Low-Skilled Labor	0.00385**	0.00357**	0.00297	0.00297	0.00350**	0.00352**	0.00298
	(0.00182)	(0.00171)	(0.00194)	(0.00194)	(0.00170)	(0.00170)	(0.00194)

Medium-Skilled Labor*Domestic Inputs	-0.033***	-0.021***	-0.025***	-0.025***	-0.021***	-0.021***	-0.025***
	(0.00329)	(0.00310)	(0.00375)	(0.00375)	(0.00310)	(0.00310)	(0.00375)
Medium-Skilled Labor*Foreign Inputs	-0.00289	0.00640**	0.00622**	0.00621**	0.00641**	0.00639**	0.00621**
	(0.00292)	(0.00265)	(0.00312)	(0.00312)	(0.00265)	(0.00265)	(0.00312)
Medium-Skilled Labor*Time	0.0014***	0.0016***	0.0016***	0.0016***	0.0016***	0.0015***	0.0016***
	(0.000223)	(0.000213)	(0.000263)	(0.000263)	(0.000213)	(0.000213)	(0.000263)
Low-Skilled Labor*Domestic	-0.00135	0.0052***	0.0086***	0.0086***	0.0053***	0.0053***	0.0086***
	(0.00209)	(0.00190)	(0.00233)	(0.00233)	(0.00190)	(0.00190)	(0.00233)
Low-Skilled Labor*Foreign Inputs	-0.000087	0.000688	0.0000219	0.0000231	0.000666	0.000665	0.0000272
	(0.00185)	(0.00167)	(0.00195)	(0.00195)	(0.00167)	(0.00167)	(0.00195)
Low-Skilled Labor*Time	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***
	(0.000149)	(0.000144)	(0.000178)	(0.000178)	(0.000144)	(0.000143)	(0.000178)
Domestic Inputs*Foreign Inputs	-0.09***	-0.103***	-0.104***	-0.104***	-0.103***	-0.103***	-0.104***
	(0.00249)	(0.00264)	(0.00301)	(0.00301)	(0.00264)	(0.00264)	(0.00301)
Domestic Inputs*Time	0.001***	-0.0007**	-0.000625	-0.000625	-0.0008**	-0.0007**	-0.000626
	(0.000325)	(0.000326)	(0.000396)	(0.000396)	(0.000325)	(0.000325)	(0.000396)
Foreign Inputs*Time	0.0017***	0.0035***	0.0036***	0.0036***	0.0034***	0.0034***	0.0037***
	(0.000265)	(0.000260)	(0.000314)	(0.000314)	(0.000260)	(0.000260)	(0.000314)
Return to Scale effects							
Capital*Capital	0.0130***	0.0097***	0.0094***	0.0094***	0.0097***	0.0097***	0.0094***
	(0.000860)	(0.000877)	(0.00103)	(0.00103)	(0.000876)	(0.000876)	(0.00103)
High-Skilled Labor*High-Skilled Labor	0.002***	0.0018***	0.0021***	0.0021***	0.0018***	0.0018***	0.0021***
	(0.000376)	(0.000353)	(0.000408)	(0.000408)	(0.000353)	(0.000353)	(0.000408)
Medium-Skilled Labor*Medium-Skilled Labor	-0.009***	-0.012***	-0.01***	-0.01***	-0.012***	-0.012***	-0.01***
	(0.00179)	(0.00163)	(0.00187)	(0.00187)	(0.00163)	(0.00163)	(0.00187)
Low-Skilled Labor*Low-Skilled Labor	0.0007***	0.0012***	0.0012***	0.0012***	0.0012***	0.0011***	0.0012***
	(0.000253)	(0.000233)	(0.000274)	(0.000274)	(0.000233)	(0.000233)	(0.000275)

Domestic Inputs*Domestic Inputs	0.0800***	0.0615***	0.0607***	0.0607***	0.0614***	0.0614***	0.0607***
	(0.00156)	(0.00189)	(0.00216)	(0.00216)	(0.00189)	(0.00189)	(0.00216)
Foreign Inputs*Foreign Inputs	0.0507***	0.0509***	0.0506***	0.0506***	0.0509***	0.0510***	0.0506***
	(0.00134)	(0.00138)	(0.00161)	(0.00161)	(0.00138)	(0.00138)	(0.00161)
Time*Time	0.0002***	0.0003***	0.0002***	0.0002***	0.0003***	0.0003***	0.0002***
	(0.000053)	(0.000052)	(0.000064)	(0.000064)	(0.000052)	(0.000052)	(0.000064)
Dummy NRCA (New Revealed Comparative Advantage		-0.130***	-0.119***	-0.119***	-0.131***	-0.131***	-0.119***
		(0.00367)	(0.00445)	(0.00445)	(0.00366)	(0.00365)	(0.00445)
constant	-1.370***	-0.0132	-0.342**	-0.342**	-0.0200	-0.0156	-0.342**
	(0.100)	(0.144)	(0.168)	(0.168)	(0.145)	(0.145)	(0.168)
TREATMENT EQUATIONS ***New Revealed Comparative Advantage - Dummy Var.***							
Capital/Labor (lagged)		0.000***	0.000**	0.000**	0.0000***	0.000***	0.000**
		(0.000006)	(0.000007)	(0.000007)	(0.000006)	(0.000006)	(0.000007)
High-Skilled Labor/Low-Skilled Labor (lagged)		-0.016***	-0.017***	-0.017***	-0.016***	-0.016***	-0.017***
		(0.00224)	(0.00258)	(0.00258)	(0.00223)	(0.00223)	(0.00258)
High-Skilled Labor/Medium-Skilled Labor (lagged)		-0.0398**	-0.0528**	-0.0529**	-0.046***	-0.048***	-0.0527**
		(0.0167)	(0.0209)	(0.0209)	(0.0168)	(0.0168)	(0.0209)
Foreign Inputs/Domestic Inputs (lagged)		-0.0129	-0.0290*	-0.0289*	-0.0167	-0.0171	-0.0290*
		(0.0111)	(0.0152)	(0.0152)	(0.0110)	(0.0109)	(0.0152)
Exchange Rate (lagged)		-0.015***	-0.0244**	-0.0246**	-0.0133**	-0.0142**	-0.0246**
		(0.00583)	(0.0107)	(0.0107)	(0.00585)	(0.00584)	(0.0107)
Economic Institutions (Rule of Law)			0.0929***				0.0953***

(lagged)							
			(0.0139)				(0.0188)
Economic Institutions (Rule of Law) - distance from the mean (lagged)				0.0933***			
				(0.0139)			
Financial Institutions (lagged)					0.195***		-0.0146
					(0.0452)		(0.0753)
Financial Institutions - distance from the mean (lagged)						0.278***	
						(0.0483)	
Costant		-0.093***	-0.155***	-0.074***	-0.204***	-0.088***	-0.148***
		(0.0136)	(0.0198)	(0.0182)	(0.0289)	(0.0137)	(0.0407)
Observations	18881	17458	12175	12175	17458	17458	12175
adj. R-sq	0.998						
/athrho		1.227***	1.150***	1.150***	1.231***	1.233***	1.150***
		(0.0234)	(0.0291)	(0.0291)	(0.0233)	(0.0232)	(0.0291)
/lnsigma		-2.155***	-2.226***	-2.226***	-2.154***	-2.154***	-2.226***
		(0.00946)	(0.0118)	(0.0118)	(0.00942)	(0.00939)	(0.0118)
Wald Test of Indep. Eq. (Prob > Chi2)	0	0	0	0	0	0	0

Standard errors in parentheses
Source: WIOD dataset, Kaufmann et al (2009) Worldwide Governance Indicators (WGI), IMF Financial Development Indexes
*p<.1; **p<.05; ***p<0.1.

First of all, we checked for the existence of endogeneity by calculating the endogenous treatment with a simultaneous equation. In this case, we add another variable in our base regression, a dummy variable, the New Revealed Comparative Advantage.

It is important to highlight that by using NRCA we actually end up having the same problem as with RCA regarding the magnitude of the comparative advantage. With both measures we cannot, again, calculate the exact magnitude because of asymmetry due to the existence of a left bound. Even though, this is not a problem for us because we use this variable as a dummy which assumes the value of 1 if there is a comparative advantage and the value of 0 if there is a comparative disadvantage[43].

We can, therefore, affirm that the dummy variable determines the pattern of trade. It reflects Heckscher-Ohlin model which is based on Ricardo's theory of comparative advantage[44]. According to this theory, there is no need for any country to be the best in anything in order to take advantage from trade. In fact, the reasons from trade are various. There can be an advantage from trade if there exists a difference in technology (see Ricardo's theory), or differences in resource of endowments (see Heckscher-Ohlin model). Other cases of advantage from trade are due to the presence of economies of scale in process of goods production or if either demand or preferences differ between countries. Another reason could be the presence of subsidy programs or government tax because these policies can have a deep effect on prices charged for goods and services. Since we are taking into consideration many countries around the world (39 countries in total), the Ricardian model is recalling us about a relevant point: it does exist a

[43] The comparative advantage or disadvantage is referring to a specific firm, into a specific country for a precise year.

[44] Dornbusch et al (1977) distinguish among continuum of goods in a Ricardian model but we do not apply this disctinction.

possibility of competition between an industry in a developed country and in industry in a less-developed country (LDC) regardless of the fact that LDC industries have a much lower labor costs. Even though, Ricardo assumes that the presence of comparative advantage is possible thanks to the international differences in productivity of the only one factor of production taken into consideration, labor. This assumption is a bit narrow therefore we prefer to believe that trade is partly explained by differences in labor productivity and in countries' resources.

For the moment, in our model, we imply that the only source of trade is resources differences and comparative advantage is affected by the relative abundance of factors of production and the technology of production. In fact, the latter affects the relative intensity of the different factors of production. In this case, the interaction between abundance and intensity is emphasized. Therefore, two main topic of interest are the proportion of availability of the different factors of production in the different countries and the proportion of the same factor of production that are used in order to obtain the different goods.

In our case, we are considering the H-O model, based on Ricardo's theory, through the addition of the NRCA dummy variable in our base regression. We have, therefore, a binary endogenous variable[45]. This is also the reason why we adopt a simultaneous regression where the first regression is our base line where we add the NRCA dummy variable and the second equation has the above mentioned dummy variable as dependent variable and a set of covariates.

[45] Vella and Verbeek (1999) use a similar approach with censored endogenous variable.

The latter are in the form of ratio in accordance with the H-O model where the main concept deals with different endowments of factors of production among countries which are represented as ratios. In our model, the factors of production are capital, labor and intermediate goods, therefore, our covariate for capital is the ratio between real fixed capital stock in US dollars[46] over the number of persons engaged (in thousands). Labor, instead, is represented by two different ratios; one of them is the ratio of the share in total hours of hours worked by high-skilled persons engaged over the share in total hours of hours worked by medium-skilled persons engaged. The second variable that represent labor is the ratio of the share in total hours of hours worked by high-skilled persons engaged over the share in total hours of hours worked by low-skilled persons engaged. In this case we have only two covariates for labor instead of three because of the risk of multi-collinearity. The domestic and foreign value of trade is defined by the ratio between foreign and domestic inputs. Another ratio is added, apart from the factors of production, and it is the exchange rate. This decision is a consequence of the fact that the original data are all in national accounts and the exchange rate has been used to convert the data into US dollars.

All the covariates are not in log anymore because we take them in level and we calculate the ratio therefore it does not make sense to apply the logarithm in this case.

Another characteristics is that all the covariates of the second equation are lagged because it is more meaningful from an

[46] Recall that we have the value of real fixed capital stock in national currencies (where 1995 is the base year) therefore we need to multiply it by the exchange rate in order to get its value in US dollar.

economic point of view. In fact, we assume that these covariates in ratio explain the presence of a comparative advantage or disadvantage which is calculated at the end of the year. This means that the relative factor of production of the year before can explain the comparative advantage of the year after.

The results of the simultaneous equations, are shown in table 6, column 3. As we can see from the table, most of the coefficients are again highly significant and NRCA dummy variable is one of them as well. Even though, the main result of this regression is the fact that the Wald test of independence equation is rejected which means that there actually is a dependence between the two equations and we did not solve the problem of endogeneity by the system of simultaneous equations. There should be some other relevant covariates to be added in the second equation of the simultaneous system that can release the endogeneity problem.

4.4.3 System of Simultaneous Equations and Institutions

In accordance with the theory, as we already mentioned in the literature review, institutions should be a key point in overcoming the problem of endogeneity by adding it as index, in the second equation of the simultaneous system. It will be considered as part of the group of covariates that determine the path of trade given by the existence of comparative advantage. We use a system of simultaneous equations, keeping as a reference the approach offered by Angrist (2001).

We have two different index representing institutions, economic institution and financial institution, which has been explained in the third section (see 3.2 and 3.3). We have two

different regressions for each index and the number of observations changes as well. One difficult task is that of choosing the right existing index for institution because, as it is widely known, this is quite a multifaceted index. In fact, it is defined as the level of political stability or rule of law or the level of democracy in a country and so on and so forth. The best index is for institution is the one that reflects better the dependent variable. In our case, our dependent variable is the pattern of trade given by the comparative advantage therefore we think that economic institution and financial institution are best for describing our NRCA dummy variable. The first index is the economic institution index representing the rule of law developed by Kaufmann et al. (2009 and 2011) which covers all the countries that we are analyzing but not the whole time interval that we are considering. In fact, the years included in the Kaufmann index are 1996, 1998, 2000 and from 2002 up to 2014[47]. We include the index in the second equation in a lagged form. We lose some information due to the fact the WGIs are not available for each year of our sample; since data in some years is missing the number of observations is lower; however, this does not render our analysis ineffective. We run the same regression but this time, instead of the index itself, we calculate and we add the distance of the economic institution from the mean, in order to get a more meaningful information.

The results are shown in table 6, column 4 and 5. Interestingly, in both cases we obtain almost the same magnitude for the coefficients and almost the same standard error. Almost all the covariates are highly significant including

[47] We will use the index up to year 2009 because this is the upper bound that is available from WIOD.

NRCA and the rule of law index, both lagged and distance from the mean. There are also few non-significant covariates such as the square of middle-skilled workers, the interaction terms between middle-skilled and high-skilled workers, medium-skilled workers and foreign inputs, low-skilled workers and time. Even though, the results are rejecting again the hypothesis of independent equation (see Wald test, last row).

In order to check the robustness of our conclusions, we run other regressions by adopting another index for institution. In fact, the type of index that you can choose may affect sometimes quite significantly your results which, as a consequence, loose part of their robustness. Our second index for institution is a recently developed measures of financial development by International Monetary Fund (Sahay et al, 2015). The financial institution index captures the financial institutions quality. We add this index as part of the covariates that determine the path of trade and comparative advantage in the second equation of the simultaneous system. First, we simply add the index and then we try by adding the distance from the mean of the same index. The results are shown in table 6 column 6 and 7.

Table 7. Robustness check: three groups of countries and Cobb-Douglas

	Group 1	Group 2	Group 3	Cobb-Douglas
Capital	0.0527***	-0.717***	0.327*	0.439***
	(0.0152)	(0.0690)	(0.167)	(0.00443)
High-Skilled Labor	0.150***	-0.0558	0.789***	0.00689***
	(0.0283)	(0.0399)	(0.172)	(0.00236)
Medium-Skilled Labor	-0.251***	0.181	-1.043***	0.158***
	(0.0321)	(0.112)	(0.342)	(0.00592)
Low-Skilled Labor	0.0131	-0.235**	0.156	0.0117***
	(0.0219)	(0.116)	(0.263)	(0.00290)
Domestic Inputs	0.611***	1.439***	0.330**	0.203***
	(0.0388)	(0.0968)	(0.156)	(0.00613)
Foreign Inputs	0.648***	0.324***	0.0736	0.310***
	(0.0341)	(0.0864)	(0.125)	(0.00573)
Time	-0.0178***	-0.0620***	-0.0205	-0.0102***
	(0.00238)	(0.00840)	(0.0156)	(0.000391)
Substitutability and Complementarity effects				
Capital*High-Skilled-Labor	-0.0253***	0.00689*	0.00348	
	(0.00286)	(0.00417)	(0.00788)	
Capital*Medium-Skilled-Labor	0.0542***	-0.0191***	-0.0396***	
	(0.00272)	(0.00731)	(0.0148)	
Capital*Low-Skilled-Labor	0.00564***	0.0398***	0.00801	
	(0.00134)	(0.00586)	(0.00968)	
Capital*Domestic Inputs	-0.0109***	-0.0803***	-0.0794***	

	(0.00256)	(0.00592)	(0.00739)
Capital*Foreign Inputs	-0.0267***	-0.0104*	0.000416
	(0.00214)	(0.00580)	(0.00588)
Capital*Time	0.000223	0.00165***	-0.00108*
	(0.000201)	(0.000579)	(0.000630)
High-Skilled Labor*Medium-Skilled Labor	-0.00467*	0.00603**	0.0255*
	(0.00282)	(0.00258)	(0.0134)
High-Skilled Labor*Low-Skilled Labor	-0.00668***	-0.00780**	-0.0466***
	(0.00202)	(0.00361)	(0.0128)
High-Skilled Labor*Domestic Inputs	0.0238***	0.000780	-0.00325
	(0.00437)	(0.00522)	(0.00879)
High-Skilled Labor*Foreign Inputs	0.0132***	-0.00837**	-0.00102
	(0.00392)	(0.00381)	(0.00708)
High-Skilled Labor*Time	-0.000244	-0.001***	-0.000209
	(0.000259)	(0.000275)	(0.000763)
Medium-Skilled Labor*Low-Skilled Labor	0.0151***	0.00413	0.0607**
	(0.00265)	(0.0101)	(0.0299)
Medium-Skilled Labor*Domestic Inputs	-0.0238***	-0.0139	0.0597***
	(0.00439)	(0.0104)	(0.0196)
Medium-Skilled Labor*Foreign Inputs	-0.0243***	0.0102	-0.0342**
	(0.00378)	(0.00866)	(0.0160)
Medium-Skilled Labor*Time	0.00143***	0.000975	0.0122***
	(0.000298)	(0.000859)	(0.00179)
Low-Skilled Labor*Domestic	-0.0145***	-0.0256***	-0.0285**

	(0.00292)	(0.00837)	(0.0128)
Low-Skilled Labor*Foreign Inputs	-0.00236	0.00819	0.0393***
	(0.00249)	(0.00725)	(0.0117)
Low-Skilled Labor*Time	-0.00071***	-0.000495	-0.0088***
	(0.000192)	(0.000571)	(0.00115)
Domestic Inputs*Foreign Inputs	-0.0853***	-0.128***	-0.0439***
	(0.00272)	(0.00901)	(0.0110)
Domestic Inputs*Time	-0.00160***	-0.00165*	-0.0041***
	(0.000380)	(0.000986)	(0.00135)
Foreign Inputs*Time	0.00120***	0.00367***	0.00219*
	(0.000303)	(0.000805)	(0.00124)
Return to Scale effects			
Capital*Capital	0.00290***	0.0427***	0.0418***
	(0.00101)	(0.00248)	(0.00431)
High-Skilled Labor*High-Skilled Labor	0.00172***	0.00453***	-0.0103***
	(0.000649)	(0.000817)	(0.00193)
Medium-Skilled Labor*Medium-Skilled Labor	-0.0101***	0.000459	-0.00827
	(0.00258)	(0.00642)	(0.0200)
Low-Skilled Labor*Low-Skilled Labor	-0.000286	-0.00647	-0.0179
	(0.000276)	(0.00486)	(0.0127)
Domestic Inputs*Domestic Inputs	0.0511***	0.108***	0.0628***
	(0.00177)	(0.00552)	(0.00730)
Foreign Inputs*Foreign Inputs	0.0591***	0.0663***	0.0216***
	(0.00159)	(0.00431)	(0.00402)

Time*Time	0.000416***	0.000127	0.00126***	
	(0.0000592)	(0.000146)	(0.000196)	
constant	-0.606***	3.949***	3.651	-3.433***
	(0.105)	(0.945)	(2.527)	(0.128)
Observations	14374	3502	1005	18881
adj. R-sq	0.999	0.998	0.997	0.994

Standard errors in parentheses;
Source: WIOD dataset;
**p<.1; **p<.05; ***p<0.1.*

Again, we obtain the same results as the economic institution index. Almost all the coefficients are highly significant, including NRCA and the new index for institution, both the lagged and the distance from the mean. Only few interaction terms are not significant: the interaction between high and medium skilled workers, medium and low skilled workers, low skilled workers and time. The index, therefore, explain part of the path of trade and determines part of the presence of comparative advantage but it does reject the hypothesis of independence.

The last column of the table is showing the results given by adding both institutional lagged index. As expected, only one of the two is significant, the economic institution. In fact, the second index, the financial institution index, is more narrow and related mostly to the financial sector while the economic institution one includes the financial sector as well. The Wald test is rejected once more. We get the same results also by adding both indexes but this time, we consider only the distance from the mean of each index. The last column of table 6 shows the results.

All of these regressions confirm previous empirical findings that institutions are a further source of comparative advantage; however neither financial nor economic institution is the key variable that breaks down the relationship of endogeneity between the specialization pattern and the output performance. Since, even after considering long-term determinants such as institutional quality, we cannot exclude the hypothesis of independence between value-added-based comparative advantage and production choices, we might argue that there may be some other overlooked sources of specialization, which also impact on the production outcomes. Recent literature strands are giving more weight not only to formal institutions, which we have considered, but also to informal institution[48] as one of those drivers able to either facilitate or hinder trade and therefore specialization. Nunn and Trefler (2013) explore the recent literature on how alternative institutions and enforcement systems emerge when formal contracting institutions are absent or weak. Interaction dynamics, firm boundaries, networks as well as beliefs and culture all impact on production choices and specialization to an extent that still need a great amount of further investigation.

4.5 Robustness Checks

Our initial results are confirmed by some robustness checks aggregated in table 7. All the findings regarding the

[48] For informal institution we consider all non-State rules and\or enforcement (see also James E. Anderson in "Trade and Informal Institution" (2008).

substitutability effect and scale effect are the result of a production function regression in the form of a translog function including all countries encountered in WIOD (39 counties worldwide). We decided to run the same regression but this time we included a sample of countries. We created three different sample of group of countries and we obtained the same findings as the one with the entire population. All the three groups confirm the presence of substitutability between high and low skilled workers and between domestic and foreign inputs. The presence of scale effects is confirmed as well. As a matter of fact, there are economies of scale for all the squared variables taken into consideration. In conclusion, all the results of the three different groups of countries confirm the baseline regression therefore support our findings.

The use of the translog functional form instead of the commonly used Cobb-Douglas production function is supported by the theory. Cobb-Douglas production function is quite simple to estimate and interpret but it has a significant limitation regarding its simplistic assumptions. In fact, it does not allow for variability of the partial elasticity of substitution (Cobb and Douglas 1928). On top of that, we have positive and diminishing marginal product therefore α and β[49] are values restricted between 0 and 1. In this work, we estimate the transcendental logarithmic production function (translog for short). It is instead more flexible as it allows for employing also more than two inputs and relaxes the restriction on the constant elasticity of substitution (Berndt and Christensen 1973). Besides, it is a

[49] In general, in the case of a Cobb-Douglas production function, α identifies the output elasticities of capital and labor, respectively.

flexible and attractive form also because it combines linear and quadratic terms (Christensen et al. 1973).

Another robustness check that is not included in the appendix B section is given by the use of pooled OLS instead of panel fixed effects. In fact, by using the within estimator, most of the results were not significant. It is true that panel fixed effect allows us to control all the variables that describe those characteristic of each country or sector that does not change along the years. Even though our translog function was chosen for its flexibility and for the time trend variable which will have to disappear because of the within estimator. In fact, the estimator applies the difference from the mean and the time trend will always be equal to zero because it does not change across the observations along one specific year. In other words, it is considered as a constant.

The above reasons motivated us to adopt OLS fixed effect as our estimator. We calculated therefore the fixed effect that corrects the intercept of each country sector considered in the dataset. The slope, therefore, is common for all the countries but the intercept changes for each country sector. Thanks to this estimator we are assuming that the time trend is independent. Our translog functional form considers the technical change and its interaction with each variable so that they can vary across time. This is another reason why OLS fixed effect is highly suggested instead of panel fixed effect. In fact, by definition, we cannot choose panel fixed effect and then add a time trend variable. Therefore, pooled OLS is the best suggested in this case, where we assume independence of the time variable. This independence is measured through the interactions of the covariate time trend with all the other variables. Our interest is

to analyze how the technical change interacts with the other factor of production.

4.6 Conclusion

There is a growing attention on novel assessments of trade and production performance and their short and long term determinants, in the light of the emergence of international value-added based supply chains. In this paper, we give a contribution on the empirical studies on institutions as sources of comparative advantage and the interdependence with production performance by making use of a relatively unexploited panel dataset, the WIOD.

First, we highlight the contribution of intermediate input sourcing from abroad and different education levels of labor force to growth. We find that there is a certain degree of substitutability between foreign and domestic intermediate inputs, such that a crowding-out effect cannot be excluded at different stages of economic integration.

Therefore, policymakers should be cautious about considerations on the benefits of greater participation to global value chains. Similarly, we find that the interdependence between labor inputs at different skill levels might create an obstacle to job creation in the development process along the value chain.

Secondly, we find that both economic and financial institutions represent a relevant determinant of the comparative advantage based on value-added and are long-term sources of

the relationship of interdependence between specialization and production performance.

Further study can be carried out to qualify specialization patterns, for instance with a metafrontier production approach, in order to introduce potential technological inefficiencies under different stages of country development. With respect to data limitations, it would be necessary to enlarge the sample by considering more countries and distinguishing them on the basis of a development stage.

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Annex

Table 1. List of countries in WIOD-dataset

European Union			**North America**	**Latin America**	**Asia and Pacific**
Austria	Germany	Netherlands	Canada	Brazil	China
Belgium	Greece	Poland	United States	Mexico	India
Bulgaria	Hungary	Portugal			Japan
Cyprus	Ireland	Romania			South Korea
Czech Republic	Italy	Slovak Republic			Australia
Denmark	Latvia	Slovenia			Turkey
Estonia	Lithuania	Spain			Indonesia
Finland	Luxembourg	Sweden			Russia
France	Malta	United Kingdom			

Table 2. List of industries in WIOD-dataset

Code	NACE	Description
1	AtB	Agriculture, Hunting, Forestry and Fishing
2	C	Mining and Quarrying
3	15t16	Food, Beverages and Tobacco
4	17t18	Textiles and Textile Products
5	19	Leather, Leather and Footwear
6	20	Wood and Products of Wood and Cork
7	21t22	Pulp, Paper, Paper, Printing and Publishing
8	23	Coke, Refined Petroleum and Nuclear Fuel
9	24	Chemicals and Chemical Products
10	25	Rubber and Plastics
11	26	Other Non-Metallic Mineral
12	27t28	Basic Metals and Fabricated Metal
13	29	Machinery, Nec
14	30t33	Electrical and Optical Equipment
15	34t35	Transport Equipment
16	36t37	Manufacturing, Nec; Recycling
17	E	Electricity, Gas and Water Supply
18	F	Construction
19	50	Sale, Maintenance and Repair of Motor Vehicles Retail Sale of Fuel
20	51	Wholesale Trade and Commission Trade, Except of Motor Vehicles
21	52	Retail Trade, Except of Motor Vehicles; Repair of Household Goods
22	H	Hotels and Restaurants
23	60	Inland Transport
24	61	Water Transport
25	62	Air Transport

26	63	Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies
27	64	Post and Telecommunications
28	J	Financial Intermediation
29	70	Real Estate Activities
30	71t74	Renting of M&Eq and Other Business Activities
31	L	Public Admin and Defence; Compulsory Social Security
32	M	Education
33	N	Health and Social Work
34	O	Other Community, Social and Personal Services
35	P	Private Household with Employed Persons
36		Financial intermediation services indirectly measured (FISIM)
37		**Total**
38		Final consumption expenditure by households
39		Final consumption exp. by non-profit organisations serving households
40		Final consumption expenditure by government
41		**Final consumption expenditure**
42		Gross fixed capital formation
43		Changes in inventories and valuables
44		Gross capital formation
45		Exports
46		**Final uses at purchasers' prices**
47		**Total use at purchasers' prices**

Table 3. Definition of skills in WIOD SEA

WIOD skill-type	1997 ISCED level	1997 ISCED level description
Low	1	Primary education or first stage of basic education
Low	2	Lower secondary or second stage of basic education
Medium	3	(Upper) secondary education
Medium	4	Post-secondary non-tertiary education
High	5	First stage of tertiary education
High	6	Second stage of tertiary education

Appendix A

Appendix for Chapter 2

A.1 Amazon Mechanical Turk and Limesurvey

To implement the online survey in the US in a short time I used the service offered by Amazon, known as Amazon Mechanical Turk. It was created in 2005 and its name comes from an amusing historic event of the 18th century[50]. MTurk is a crowdsourcing web service which aim is that of coordinating the supply and the demand of task which can be completed only by human intelligence. More specifically, it is an online labour market where two figures play a key role: the employees, called

[50] The historic event related to the name given to the service offered by amazon happened in 1769 when a Hungarian nobleman called Wolfgang von Kempelen was able to amaze Europe thanks to his invention: a mechanical chess-playing automaton which almost defeated every opponent. This mechanical tool was accompanied by a life-sized wooden mannequin dressed with a fur-trimmed robe and a turban which contributed to call it Kempelen's "Turk". The mannequin was seated behind a cabinet and became well-known in all Europe. In order to persuade people in believing in his invention, Kempelen used to slide open the cabinet's door to reveal part of the mechanism behind it: a set of gears, cogs and springs. Kempelen managed to convince people that his invention was able to make decisions using only artificial intelligence. Actually, the hidden true was that inside the machine it was cleverly concealed a chess master. For a more detailed information see also: https://requester.mturk.com/help/faq#what_is_amazon_mechanical_turk.

otherwise *workers* in amazon, who are hired by the employers, called *requesters*, are supposed to execute one or some tasks, called *HIT/s* (an acronym that stands for Human Intelligence Task). In exchange, the workers, or better call them respondents, get a wage or *reward*.

The anonymity is ensured for both respondents and requesters, even though there is the possibility for both to communicate through an ID provided by Amazon. HITs are posted by requesters and there is the possibility to show them only to specific respondents who accomplish predefined criteria such as country of residence, certain level of completion rate, number of hits already approved and many more. Even though, the first three criteria are considered System Qualifications and are freely offered by amazon while any other more specific one, such as marital status, car owner, US political affiliation, household income and so on and so forth, are called Premium Qualifications and are significantly more expensive. On the other side, respondents can freely decide what task to execute. They can sort them according to some criteria such as size of the reward and the maximum time allotted for the completion of the task. In addition, brief descriptions of the task and relative previews are allowed for the respondents before accepting it.

In general, tasks are quite simple and takes few minutes to complete them, even though usually requesters allocate even up to one or two hours so that respondents can do it partially and complete it later without feeling pressured by the time constraint. At the completion of the task, the requester can pay the respondent. There are many ways that amazon adopt to protect both sides of the labour market. In fact, if a respondent executes a good task then the requester can give him a bonus or,

differently, if the respondent executes the HIT with poor quality then the requester can refuse the payment or even block the respondent from completing future tasks. On the other side, if a requester does not give sufficient explanation regarding the rejection of a respondent, then the former can be filtered out by the respondent in order to avoid future exploitation. As far as the speed of recruiting is concerned, generally it does not take long, even though it also depends on the main characteristics of the HIT such as the payment (see Burhmester et al., 2011), the time constraint and so on and so forth. In our case, it took us less than three days, by recruiting only few hours each day during daylight, to collect slightly less than 400 respondents. Thanks to this, MTurk offers the possibility of running experiments that require interactions between respondents, such as the case of a game theory experimental designs or group decision-making.

Mechanical Turk presents a set of advantages and disadvantages as well (see Mason and Suri, 2012). First of all, online experiments per se include a series of benefits which are widely explained in former work (see Reips, 2000, 2002). Apart from those, MTurk seems to include also a series of unique advantages: (i) subject pool access, (ii) subject pool diversity and (iii) low cost. This means that, thanks to MTurk, there exist a significant amount of people that remains relatively stable over time (see Ipeirotis, 2010). This characteristic allow also the possibility of doing longitudinal studies by preserving people's identity and anonymity simply through their amazon ID. Summing up, the main characteristic of MTurk is the availability of having access to a large, stable pool of people, coming from a very diverse background (see Eriksson & Simpson, 2010) and willing to participate in experiments for relatively low pay, in

comparison to other online recruitment methods (see Paolacci et al. 2010) or paid laboratory subjects.

On the other side, MTurk presents some drawbacks as well, and one of them is the fact that the population of respondents is not representative, for the moment, of any one country or region. This is also due to the fact that Internet users differ systematically from non-Internet users. In fact, respondents seem to be younger, overeducated, underemployed, less religious and more liberal in comparison to the general population (see Berinsky, Huber, & Lenz, 2012; Paolacci et al., 2010; Shapiro, Chandler, & Mueller, 2013). Even though, in 2014 was reported that MTurk workforce is composed of more than 500,000 individuals from approximately 190 countries. Besides, there are consistent demographic surveys that confirm the presence of mainly respondents with residence in the United States and India while less than a quarter of them reside in other countries (see Paolacci et al., 2010; Ross et al., 2010). Another aspect is the average payment to the repondents which is actually below the minimum federal hourly wage. This leads to questions about the reasons that drive people to accept and complete task. Surprisingly, respondents list both extrinsic and intrinsic reasons such as "to make basic ends meet" and "because tasks are fun". Therefore, monetary award is not the only motivation (see Paolacci, Chandler, & Ipeirotis, 2010; Ross, Irani, Silberman, Zaldivar, & Tomlinson, 2010).

Some doubts may arise when it comes to assure that the HITs are completed by different respondents. Likely, each respondent, as I already mentioned, has his or her own WorkerID and amazon prevent respondents by completing the same task twice by default. Even though, there is actually the possibility for a

respondent to have double current MTurk account, therefore two different WorkerIDs. To protect requesters from this event, Amazon continuously works to identify and successively eliminate double accounts. The requesters can protect themselves from these respondents by restricting well paid HITs only to those who already have a high-quality ranking regarding the past completed tasks because it is supposed to be less likely for those respondents to take the risk of creating a second profile. Moreover, according to a study (see Berinsky et al., 2012), it was revealed that, by analysing IP addresses, only a very small fraction of respondents, approximately 2.5%, submit HITs from the same IP address. Even though, double IP addresses often means that respondents are separate members of the same household. In fact, another study (see Shapiro et al., 2013) did a specific research on this issue by tracking demographic responses and IP addresses across time points and found out that 2.8% of respondents used to share the same IP address with at least one other respondent. The positive side is that most of these individuals reported consistent demographic characteristics supporting the idea of distinct individuals inside the same household. This suggests that the number of respondents with double amazon accounts is lower than simply analysing the IP address[51].

After using MTurk, I can easily confirm the fact that this service is extremely efficient when it comes to link a new

[51] In my sample of randomized online experiment, I have seven couples with the same IP account. I checked the answers and it is very likely that it is the case of respondents living in the same household. Most of the time it seems that they are couples living together and using the same computer to answer the survey.

hypothesis with testing it, analyse the results and update the theory. In fact, in the past, the recruiting process has always been very long in terms of timing and expensive too. Thanks to amazon and to its large pool of subjects online, I could overcome these two problems in less than three days with a very limited cost. Of course, I cannot claim that MTurk is the best methods to conduct behavioural research comparing to all the others but, if I consider all its characteristics, I can surely affirm that taken as a whole, MTurk can be very useful and fairly correct as a tool for many researchers.

There are different ways of creating a HIT. One possibility is using the rudimentary in-house survey platform offered by MTurk, even though this is not very recommended because of its several constraints and its poor user-friendly presentation. Another solution is providing a link to an external site for respondents interested in your hit. This is my case and I used Limesurvey as external link.

Limesurvey is software that gives you the possibility to quickly create intuitive powerful online question-and-answer surveys. The main advantages are being self-guiding for the respondents participating to the survey and a relatively low monthly cost comparing to other services. Limesurvey offers different options to customize my survey. In fact, I asked the software to record the IP address as well. Other options that I adopted were: a question by question format, compulsory answer to continue in the next section, a short welcome screen, show progress bar, allow backward navigation, show the number of questions present in the survey, set cookie to prevent

repeated participation, use of CAPTCHA[52], responses were date stamped, responses had their IP address and their referring URL logged, timing was saved, anonymized responses, use HTML format for token emails and send confirmation emails. At the end of the survey I gave a code as well that respondents were supposed to put in amazon so that they could be paid by 24 hours[53].

A.2 Robustness Checks remaining Tables with the addition of the Interaction Terms

Here there are all the remaining tables regarding the addition of the interaction terms for all the rest of the questions in the online survey. Those tables show no significance in the interaction terms.

[52] Described in detail in the next section.

[53] When presenting the task in amazon I wrote that in order to get the payment, they would have to finish the survey to obtain the code for the payment. Actually, I paid them anyway because I was relying also to the fact that all the questions were compulsory to proceed and I was trusting the fact that the people selected had a completion rate of 95%. That was the case. The total number of drops was almost irrelevant, 7 respondents out of 416, less than 1.7%.

Table 10e. Comparison between the benchmark and the results of the treated with interaction terms

	Drinking perceived healthy product					
	Benchmark	Male	Unempl.	Married	Child	College
Treated	0.421***	0.376***	0.418***	0.444***	0.429***	0.445***
	-0.045	-0.072	-0.046	-0.054	-0.053	-0.059
Male	-0.111**	-0.151**	-0.11**	-0.112**	-0.11**	-0.111**
	(0.05)	(0.07)	(0.05)	(0.05)	(0.05)	(0.05)
Unemploy.	-0.047	-0.04	-0.088	-0.042	-0.045	-0.045
	(0.092)	(0.092)	(0.131)	(0.093)	(0.093)	(0.092)
Married	-0.096*	-0.092	-0.096*	-0.059	-0.097*	-0.098*
	(0.058)	(0.058)	(0.057)	(0.073)	(0.058)	(0.058)
Child	-0.019	-0.02	-0.019	-0.02	-0.013	-0.018
	(0.024)	(0.024)	(0.024)	(0.024)	(0.031)	(0.024)
College	0.069	0.07	0.069	0.068	0.07	0.097
	(0.045)	(0.045)	(0.045)	(0.046)	(0.045)	(0.065)
Inter. Term (treated*1,2, 3,4,5)		0.075	0.065	-0.073	-0.011	-0.054
		(0.092)	(0.184)	(0.098)	(0.04)	(0.091)
Constant	0.22	0.241*	0.224	0.216	0.216	0.216
	-0.137	-0.14	-0.138	-0.136	-0.137	-0.136
Interaction term	No	Yes	Yes	Yes	Yes	Yes
N	409	409	409	409	409	409

Standard errors in parentheses.
The level of significance is the following:
****Significant at the 1 percent level;*
***Significant at the 5 percent level;*
**Significant at the 10 percent level.*

Table 10f. Comparison between the benchmark and the results of the treated with interaction terms

	Govn't should be strict on sugar as with alcohol					
	Benchmark	Male	Unempl.	Married	Child	College
Treated	0.116**	0.105	0.111**	0.136**	0.113**	0.111*
	-0.048	-0.077	-0.049	-0.058	-0.056	-0.066
Male	0.003	-0.006	0.006	0.002	0.003	0.003
	(0.056)	(0.076)	(0.056)	(0.056)	(0.056)	(0.056)
Unemploy.	0.08	0.081	0.004	0.083	0.079	0.079
	(0.113)	(0.114)	(0.184)	(0.114)	(0.114)	(0.114)
Married	0.059	0.06	0.059	0.09	0.06	0.06
	(0.061)	(0.061)	(0.061)	(0.081)	(0.061)	(0.061)
Child	0.013	0.013	0.013	0.013	0.01	0.013
	(0.024)	(0.024)	(0.024)	(0.024)	(0.032)	(0.024)
College	-0.09*	-0.089*	-0.09*	-0.09*	-0.09*	-0.095
	(0.048)	(0.048)	(0.049)	(0.049)	(0.048)	(0.068)
Inter. Term (treated*1,2,3,4,5)		0.019	0.121	-0.061	0.005	0.011
		(0.098)	(0.234)	(0.105)	(0.039)	(0.097)
Constant	-0.043	-0.038	-0.036	-0.047	-0.041	-0.042
	-0.147	-0.15	-0.147	-0.147	-0.148	-0.147
Interaction term	No	Yes	Yes	Yes	Yes	Yes
N	409	409	409	409	409	409

Standard errors in parentheses.
The level of significance is the following:
****Significant at the 1 percent level;*
***Significant at the 5 percent level;*
**Significant at the 10 percent level.*

Table 10g. Comparison between the benchmark and the results of the treated with interaction terms

	Said would petition for tax on profits					
	Benchmark	Male	Unempl.	Married	Child	College
Treated	0.066	0.087	0.066	0.065	0.082	-0.003
	-0.048	-0.076	-0.049	-0.059	-0.056	-0.065
Male	-0.022	-0.004	-0.022	-0.022	-0.02	-0.022
	(0.055)	(0.077)	(0.055)	(0.055)	(0.055)	(0.054)
Unemploy.	-0.119	-0.123	-0.122	-0.119	-0.115	-0.126
	(0.122)	(0.123)	(0.179)	(0.123)	(0.124)	(0.126)
Married	0.021	0.02	0.021	0.02	0.019	0.028
	(0.061)	(0.061)	(0.061)	(0.082)	(0.061)	(0.061)
Child	0.015	0.015	0.015	0.015	0.027	0.012
	(0.023)	(0.023)	(0.023)	(0.024)	(0.031)	(0.023)
College	0.008	0.007	0.008	0.008	0.01	-0.071
	(0.048)	(0.049)	(0.049)	(0.049)	(0.049)	(0.07)
Inter. Term (treated*1,2, 3,4,5)		-0.034	0.004	0.002	-0.022	0.156
		(0.098)	(0.245)	(0.103)	(0.038)	(0.097)
Constant	0.007	-0.002	0.008	0.008	-0.002	0.019
	-0.14	-0.143	-0.142	-0.14	-0.141	-0.141
Interaction term	No	Yes	Yes	Yes	Yes	Yes
N	409	409	409	409	409	409

Standard errors in parentheses.
The level of significance is the following:
****Significant at the 1 percent level;*
***Significant at the 5 percent level;*
**Significant at the 10 percent level.*

Table 10h. Comparison between the benchmark and the results of the treated with interaction terms

	Actually signed the petition					
	Benchmark	Male	Unempl.	Married	Child	College
Treated	0.116***	0.089	0.118***	0.109**	0.13***	0.068
	-0.042	-0.063	-0.043	-0.05	-0.048	-0.055
Male	0.073	0.049	0.072	0.073	0.075	0.073
	(0.046)	(0.059)	(0.046)	(0.046)	(0.046)	(0.046)
Unemploy.	-0.093	-0.088	-0.068	-0.094	-0.089	-0.098
	(0.102)	(0.103)	(0.154)	(0.103)	(0.103)	(0.106)
Married	0.046	0.049	0.047	0.036	0.044	0.051
	(0.055)	(0.055)	(0.055)	(0.068)	(0.055)	(0.055)
Child	0.043*	0.042*	0.043*	0.043*	0.053*	0.041*
	(0.023)	(0.023)	(0.023)	(0.023)	(0.029)	(0.023)
College	-0.015	-0.015	-0.015	-0.015	-0.013	-0.071
	(0.043)	(0.043)	(0.043)	(0.043)	(0.043)	(0.057)
Inter. Term (treated*1,2,3,4,5)		0.046	-0.039	0.02	-0.018	0.11
		(0.084)	(0.206)	(0.091)	(0.036)	(0.085)
Constant	-0.246**	-0.233*	-0.248**	-0.245**	-0.254**	-0.237*
	-0.123	-0.125	-0.124	-0.123	-0.124	-0.122
Interaction term	No	Yes	Yes	Yes	Yes	Yes
N	409	409	409	409	409	409

Standard errors in parentheses.
The level of significance is the following:
****Significant at the 1 percent level;*
***Significant at the 5 percent level;*
**Significant at the 10 percent level.*

A.3 Randomized Online Survey

Below, I list the set of questions present in the omnibus randomized survey. The only difference between the treated and the control group is that in the first one I have the information written in italic style while in the control, there are only the questions. Another little difference is the statement of the petition which has to be slightly different so that I could build two petitions with the same content but with a different formulation in the same website.

The survey URL for the treated group is the following: http://emisilvi.limequery.com/915996?lang=en; while the survey URL for the control group is: http://emisilvi.limequery.com/137827?lang=en.

OMNIBUS RANDOMIZED SURVEY

1) What is your gender?

Male Female

2) What is your age? Numeric number only

3) What is your marital status?

Single Married Divorced Widowed/Widow

4) How many children do you have?

Numeric number only

5) How would you describe your ethnicity/race?

European American/White African American/Black
Hispanic/Latino Asian/Asian American Other

6) Do you have U.S. citizenship? Yes No

7) Which category best describes your highest level of education?

Eight grade or less 4-year College Degree
Some high school Master's Degree
High school degree/GED Doctoral Degree
Some college Professional Degree (JD, MD, MBA)
2-year college degree

8) What is your current employment status?

Full-time employee Unemployed and looking for work
Part-time employee Student
Self-employed or small business owner
Not in labor force (i.e. retired, full-time parent, not looking for job anymore)

9) What was your TOTAL household income, before taxes, last year (2016)?

$0 - $9,999
$10,000 - $14,999
$15,000 - $19,999
$20,000 - $29,999
$30,000 - $39,999
$40,000 - $49,999
$50,000 - $74,999
$75,000 - $99,999
$100,000 - $124,999
$125,000 - $149,999
$150,000 - 199,999
$200,000+

10) Who did you support in the presidential election 2012? If you were not able to vote, just choose the person you wanted to win the election at that time.

Barack Obama Mitt Romney

11) On economic policy matters, where do you see yourself on the liberal/conservative spectrum?

Very conservative Conservative Moderate Liberal Very liberal

12) Which party did you support in the last election in November 2016?

Democratic Republican Other None

13) How much of the time do you think you can trust government in Washington to do what is right?

1. Just about always 2. Most of the time

3. Only some of the time 4. Hardly ever

14) Where would you rate yourself on a scale of 1 to 5, where 1 means you think the government should do only those things necessary to provide the most basic government functions, and 5 means you think the government should take active steps in every area it can try and improve the lives of its citizens?

1 2 3 4 5

15) Do you have a specific disease or allergy? If so, mention which ones in the comment below: …

16) How much do you weigh (in lbs)? Numeric answer only.

17) Do you read food and drink labelling when you buy one?

Never Rarely Sometimes Always

18) How many smoothies, on average, do you drink per week? Numeric answer only.

Question 19

One calorie of sugar is not the same as one calorie of proteins because the body uses different amount of energy to process them.
Added sugars are sugars and syrups put in foods during preparation or processing, or added at the table. The American Heart Association recommends no more than 9 teaspoons (tsp) of added sugar a day for men and 6 for women.
One typical can of Coca-Cola of 12 fl. oz. contains approximately 9 tsp of sugar.
One small glass of Jamba juice strawberry smoothie (real whole fruit and 100% juice) contains 17 tsp of sugar. A medium one has 23.5 tsp of sugar while a large glass has 31 tsp. If 31 tsp of sugar were taken from the original fruit instead of drinking them, then you would have to eat approximately: 4 peaches, 9 limes, 30 lemons and 30 strawberries.

Yes, it is clear
Partially clear
No, it is not clear (explain why in the comment below)

How healthy do you think it is to drink one large glass of Jamba juice strawberry smoothie made with real whole fruit and 100% juice?

very unhealthy unhealthy healthy very healthy

Question 20

In the field of food products, the bliss point is the amount of an ingredient contained in a food or drink, such as salt, sugar or fat which is able to maximize the pleasure of eating that specific food. When a company gets the bliss point right, then the product typically takes off. For example, the bliss point for Mountain Dew seems to be approximately 37 tsp of sugar (without considering the amount of other sweeteners such as high fructose corn syrup) in a bottle of 1.25 litres.
Some food perceived as healthy contains the following amount of sugar: one bar of Nutri Grain apple cinnamon cereal contains 3 tsp of sugar (both naturally and added sugars); in one small glass (240 ml) of Tropicana 100% pure orange juice there are slightly more than 5 tsp of sugar; one small container (170g or 6oz) of Dannon plain no-fat yogurt has 3 tsp of sugar.

Do you think that multinational food industry such as Coca-Cola, McDonald's, Nestlé, Kraft, Nabisco, General Mills, Procter & Gamble, Mars, Dannon, Tropicana and Kellogg's put profits ahead of people's health?

Strongly agree Agree Disagree Strongly disagree

Question 21

FDA (or Food and Drug Administration) is a federal agency in the Department of Health and Human Services responsible for monitoring trading and safety standards in the food and drug industries[54].
FDA regulates the content of labelling for food products, such as their sugar content.
There are two types of sugars in American diets: naturally occurring sugars (sugars found naturally in fruits and milk) and added sugars. Generally, the nutrition facts panel of a food does not distinguish between the two types therefore the word "sugar" includes both.
Added sugar can be easily present in our daily diet because there are more than 50 different names to describe forms of sugar.

Products that are labelled as sugar free can still contain artificial sweeteners. Moreover, since food manufacturers are not required to notify you on the front of the package when a product contains an artificial sweetener, consumers may need to check the ingredient list carefully[55].
According to FDA, a food can be labelled with the term "sugar free" or "no sugar" if the food contains less than 0.5 g of sugars per labelled serving. Moreover, they still can contain sugar alcohols, one type of reduced-calorie sweetener. It is good to keep in mind that the problem is not one serving but the amount of total serving eaten per day.
The term "lightly sweetened" is not defined by FDA, it is freely used by food industries, each applying their own definition.

[54] According to Collins English Dictionary, 12th Edition 2014.
[55] Information found in "The Sugar Association".

Food label are misleading because they try to attract potential consumers and hide unhealthy ingredients without breaking the rules settled by FDA (Food and Drug Administration is a federal agency in the Department of Health and Human Services responsible for monitoring trading and safety standards in the food and drug industries):

Strongly agree Agree Disagree Strongly disagree

Question 22

Over the past 50 years, sugar consumption has tripled worldwide. Some of the diseases induced by sugar consumption are associated with metabolic syndrome such as: hypertension, high triglycerides and insulin resistance through synthesis of fat in the liver, diabetes, ageing process. Sucrose, commonly known as table sugar, is composed by glucose and fructose. Fructose exerts toxic effects on the liver which are akin to those of alcohol; in fact, alcohol comes from the fermentation of sugar. Moreover, the effect of sugar on the brain is that of encouraging subsequent intake because it does not suppress the feeling of being hungry.

For all the above reasons, some doctors claim that added sweeteners has a clear potential for abuse therefore they should be controlled, like FDA does with alcohol, because the way sugar is eaten today make it toxic and it should be regulated.

According to FDA, fructose is in the list of Generally Regarded as Safe (GRAS), which means that food manufacturers can add unlimited amounts of it to any food. It can be argued that also iron and vitamins A and D are in the GRAS list can be toxic if over-consumed but, unlike sugar, they have no abuse potential.

The government should intervene and behave towards sugar as strict as with the alcohol.

Strongly agree Agree Disagree Strongly disagree

23) Up to how much, in percentage would you pay more to have a healthier product in terms of added sugar (think about food that you regularly eat in a daily or at most weekly basis)?
Up to….% (give a percentage amount you would pay more on average)

24) Would you agree with an eventual policy that can be taken by the government in which profits of industries producing high sugar soft drinks and food should be taxed by 10% (where high is the level where one serving of a product overcome half of the daily consumption of added sugar suggested by FDA)?

Strongly agree Agree Disagree Strongly disagree

25) If you either agree or strongly agree with the policy related to the previous question, then would you also agree in using the money collected by the tax to be invested in elementary schools for free healthy food education lessons for children?

Strongly agree Agree Disagree Strongly disagree

26) Would you sign a petition where you ask for a 10% tax on profits of industries producing food and soft drinks with high sugar level (where high is the level where one serving of a product overcome half of the daily consumption of added sugar suggested by FDA)? Yes No

The claim of the petition is the following (for the treated):

We ask to the Government of United States of America to apply an additional tax of 10% on profits of industries who produce food and soft drinks with high added sugar level. For high sugar level we consider any food or soft drink in which one serving overcome half of the daily consumption of added sugar suggested by the Food and Drug Administration (3 teaspoons of added sugar is half of the daily consumption).

The claim of the petition for the control group is:

This petition wants to ask for the application of an additional tax on profits of 10% on industries producing food and soft drinks with high level of added sugar. We consider high level of added sugar all those products which contain at least three teaspoons of added sugar per serving.

27) If yes, then go to the following link to sign the existing petition (for the treated):

https://petitions.whitehouse.gov/petition/we-ask-additional-tax-10-profits-industries-producing-food-and-soft-drinks-high-added-sugar-level

The link for the control group is the following:

https://petitions.whitehouse.gov/petition/apply-additional-tax-profits-10-industries-producing-foodsoft-drinks-high-level-added-sugar

28) Did you actually go to the website and signed the petition?

Yes No

29) Do you feel that this survey was biased?

Yes, left-wing biased

Yes, right-wing biased

No, it did not feel biased

30) Please feel free to give us any feedback or impression regarding this survey.

…….

Appendix B

Appendix for Chapter 4

B.1 Dataset Description

Both dependent and covariates can be found in the WIOD dataset in two different sections: world input-output tables and socio-economic account section. All the variables taken in consideration are in log, with the exception of time trend[56]. WIOD dataset shows all the values in current prices and in millions of US dollars while the data taken from the socioeconomic section are at current basic prices in millions of national currencies. Some data are present in both section with the difference that in one section they are expressed in US dollars while, in the other one, the data are in national currency. Moreover, some data can be found in both sections but they have different currency. This is also the main reason why WIOD give data about the exchange rate as well. Besides, the data we are using are turned from current to constant value where 1995 is our base year. The price levels are again given by WIOD in the socio-economic section.

Another important note is the fact that we multiply all the variables, with the exception of the one identifying time trend,

[56] Further it will be clearer why the log of the time trend does not make any economic sense.

for one million before applying the logarithm. The reason that drives this decision is that of avoiding to get a value equal or smaller than 1, which is actually the case for many data.

Y_{ckt} = real value of gross output. Real value of gross output is calculated by multiplying gross output and exchange rate over price level of gross output[57]. The subscripts, c, k and t, identify respectively the country, the sector and the time. The dependent variable is calculated by taking the value from the socio-economic section and after the multiplication and division, it coincides with the value of the WIOD input-output tables;

$X_{ckt}^{i,j}$ = factors of production; the superscripts, i and j, identifies respectively the different covariates. The covariates we are considering are: capital, labor and intermediate goods;

Capital= capital is one of the independent variables which can be found in the socioeconomic section of WIOD and it is represented by the real fixed capital stock where the base year is again 1995. Since its value is in national currency, we had to multiply it by the exchange rate;

Labor = labor covariate is represented by the total hours worked by three different skilled-workers: high, medium and low–skilled workers. This means that we have three different variables that explain labor, or in other words, three different variables that analyze deeply the fragmentation of skilled workers in the labor market. In the socioeconomic section we

[57] Recall that the base year is always 1995=100

have the share in total hours of the different skilled workers and the total hours worked by persons engaged for each of them in millions so by multiplying the two, we get three different covariates representing labor;

Domestic Inputs= this is one of the intermediate goods. Those data correspond to all the area that matches all the industries of the same country of the WIOD dataset. More precisely, if you look at the intercountry input output table of each year, the values inside the dataset represents the inputs that a specific country and a specific industry produces for that precise year and whose inputs are used by the other home or foreign industries. This is actually the definition of intermediate good. In the case of domestic inputs, we have that the inputs of one industry of a country A are used by any other industry of the same country. In other words, domestic inputs are all the values regarding trade among industries inside their own country;

Foreign inputs= this is the second covariate identifying foreign inputs. In this case, the inputs of one industry of a country A are used by any other industry of a foreign country. Therefore, foreign inputs are all the values regarding trade among industries in different countries.

Domestic and foreign inputs are shown in millions of US dollars in nominal prices therefore we multiply them by one million and divide them by the price levels of intermediate goods, as given in the socio-economic section.

T = time trend adopted for the identification of technical change;

ε_{ckt} = error term;

According to the equation describing the translog function, apart from the covariates we have a set of interaction terms among all the single independent variables and a set of square terms of each of the listed covariates.